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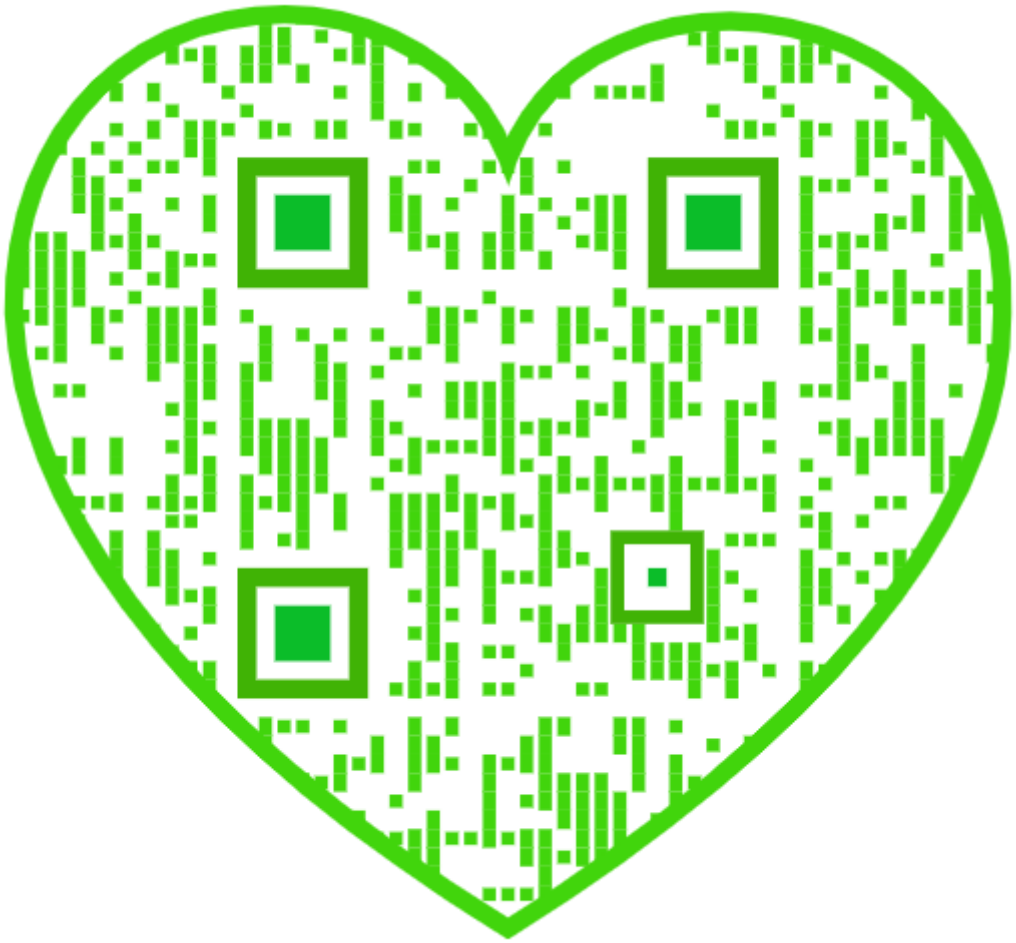

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THE

STONE-CUTTER.

A Treatise on the Different Problems of

STONE-CUTTING,

Containing Circle upon Circle Arches, Ramp and Twist, Raking Moulds, Cant Moulds, &c., &c.

By PETER HEATON, Stone-Cutter.

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INTRODUCTION.

"THE object of this Book is to give Stone-cutters some problems in practical Stone-cutting, which will be to their interest to know; something which confronts us every day, and which I believe the majority of Stone-cutters are entirely ignorant of.

In explaining them, I wish to do away with, as much as possible, the technical terms used in most books on drawing, and make everything plain, so that any beginner can make them out without trouble. The necessity for books which should show a Stone-cutter what he ought to learn has been deeply felt. It is as a contribution towards the accomplishment of this purpose that the present book is put forth, in the earnest hope of helping Stone-cutters to mount a step or two higher on the ladder of improvement.

The cost of books of this kind has prevented a large number of Stone-cutters from buying them, and my desire is to sell this book at a moderate price, so as to put it within the reach of every Stone-cutter.

The problems herein explained are given in as simple a manner as possible, so that the student may be able to follow them with interest, and may be led to desire still further instruction than is here afforded; and it is hoped the pleasure and benefit he receives may awaken in him that spirit of enthusiasm which is the mainspring of all progress.

PETER HEATON.

FIG. 1 is a cut showing a Drawing-Board, with Paper, T Square and Set Square. The best T Squares are those with the blade screwed over the butt-end, as shown, as this allows the Set Square to pass freely along. The T Square is to be worked against the left-hand edge of the Drawing-Board, and should be used for horizontal lines only; perpendiculars should be drawn by working the Set Square against the T Square, for if the T Square is used for perpendicular as well as horizontal lines, the slightest inaccuracy in the truth of the edges of the board would prevent the lines being at right angles to each other.

The best way to draw lines parallel to each other is by means of two Set Squares. Let it be required to draw several lines parallel to A B, FIG. 2—Place the edge of the Set Square C against the line, and place Set Square D against the first; hold D firmly down, and move C along the edge of D, and thus any number of parallel lines may be drawn; and if lines at right angles to the parallels are required, it is only necessary to hold C and place D on it, as shown in the dotted portion of the figure.

FIG. 3 is a method of finding the lines from which to joint a Circular Stone. Let us suppose the points A A to be the desired length of the stone; draw a straight line through the points A A, then find the center and draw the line B C; now measure the distance from B to C and mark it on a square, as shown from D to E, then set the Square to the points E A C and draw the joint lines, as shown in figure.

FIG. 1

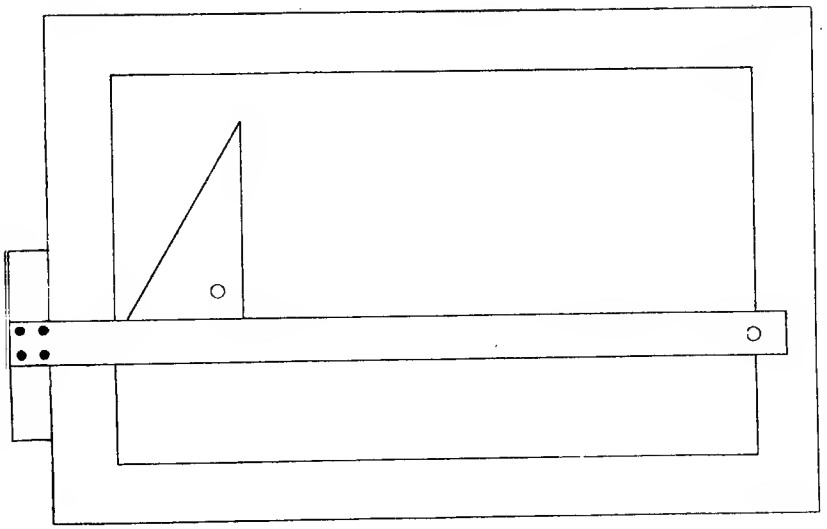
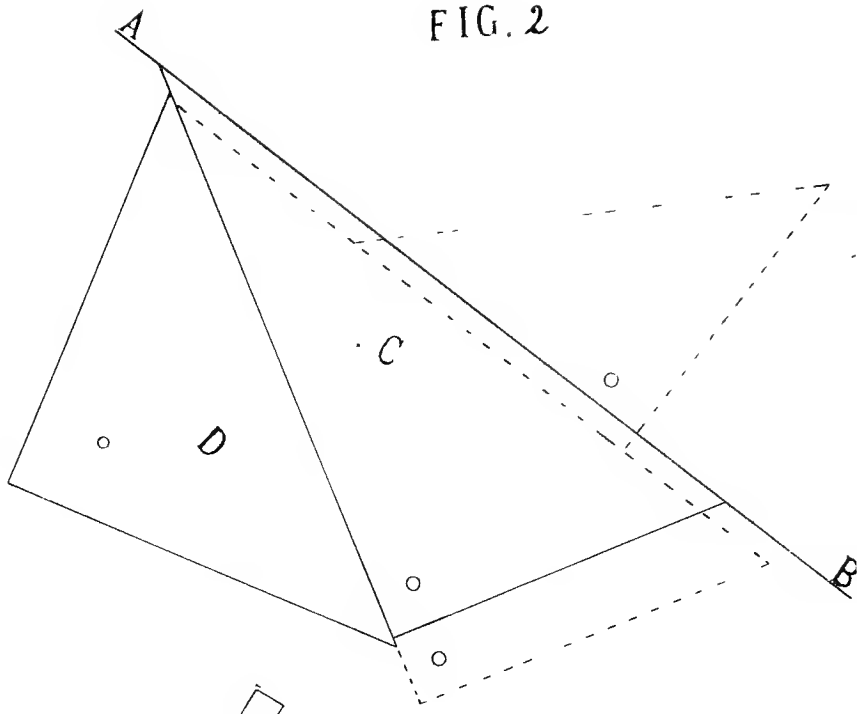


FIG. 2



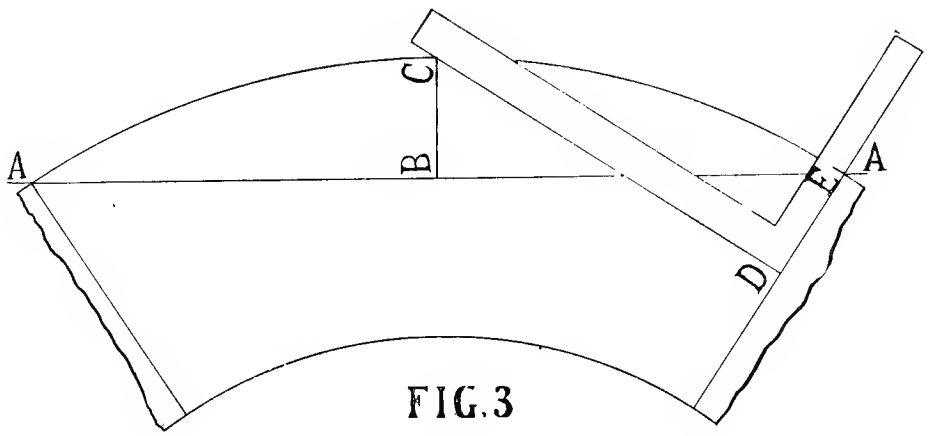


FIG. 3

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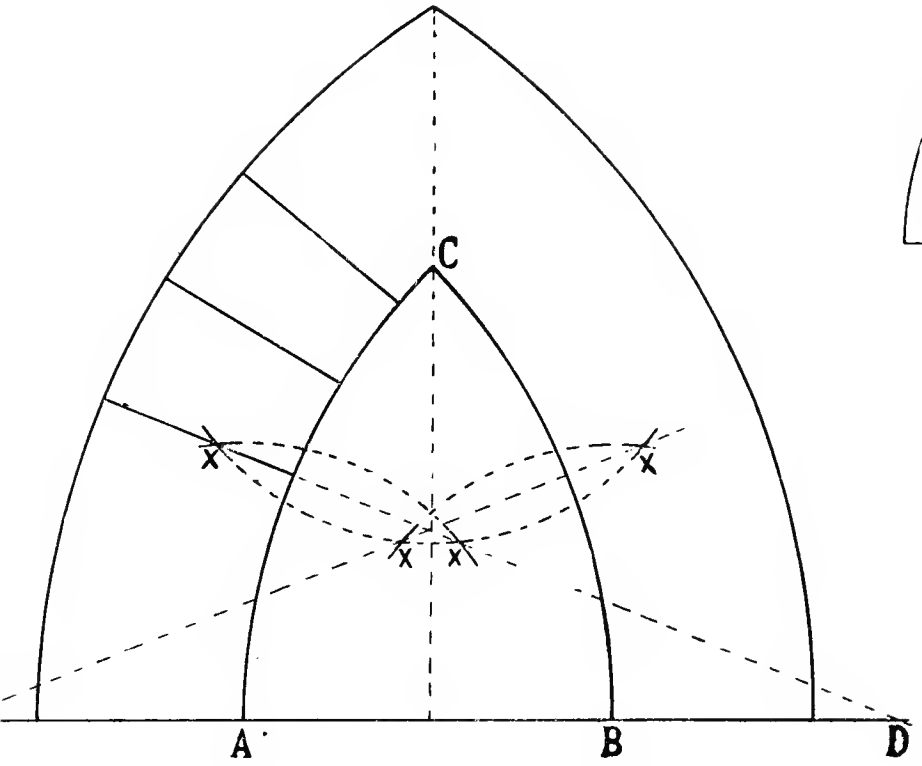
GOTHIC ARCHES.

FIG. 1 is a method of finding the centers from which to draw the Lancet Arch, the Drop Arch, and others that are struck from one or two centers.

To make FIG. 1, draw the springing and center lines and set off the opening and rise A B C, then take any distance greater than the half of C A or C B and draw the Arcs, cutting each other at X X X X, now draw a line through the points X X X X to the springing line, and D D will be the points from which to draw the Arch and its Joints.

FIG. 2 may be called an Elliptic Arch, since no portion of a true ellipse is really a part of a circle; the use of this method will be seen from the figure. Draw the springing line and set off the opening A A, now divide the opening into four equal parts and draw the dotted circles, then draw the lines O S S through the points of intersection of dotted circles, and O O O will be the points from which to draw the Arch. The joints are struck from the different centers, as shown in figure.

FIG. 1



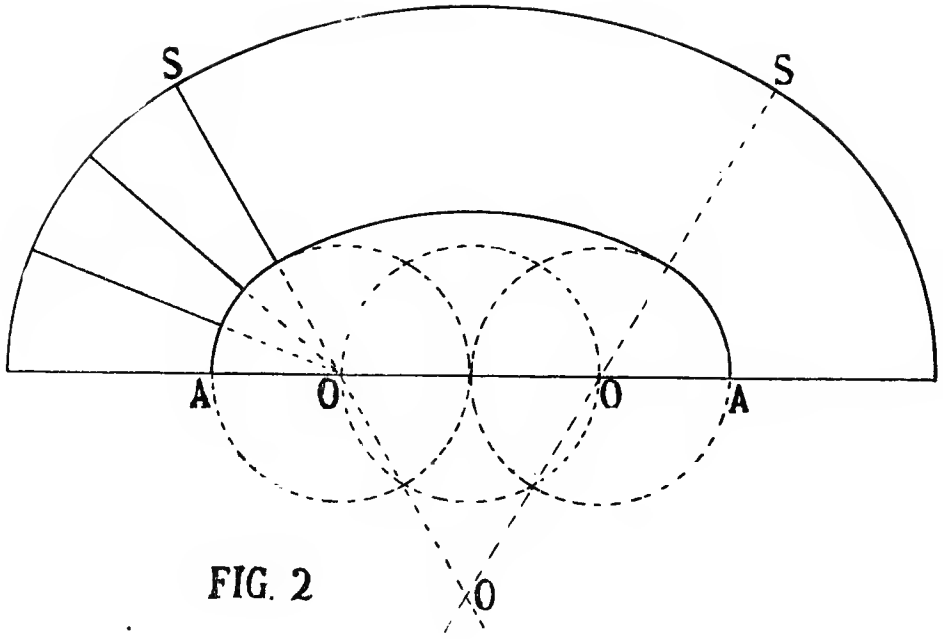


FIG. 2

GOTHIC ARCHES.

FIGS. 1 and 2 show two more ways to draw the Elliptic Arch. FIG. 1 is drawn with the compass, and FIG. 2 with a cord or string. To find the centers from which to make FIG. 1 to a given size, first draw the springing and center lines and set off the required opening and rise, as A B C; divide the rise into three equal parts, as 1 2 3, and take any distance greater than the half of 1 C, and draw the Arcs, intersecting each other at S S; then draw a line through S S, cutting the center line, and O will be one center; now draw the line O 3, and where it cuts the springing line is another center. Then make x T equal to x P, and O T P will be the three points from which to draw the Arch. The joints are struck from the different points, as shown in figure.

FIG. 2 is what we will call the String Method, and is a simple way of making an Elliptic Arch. Draw the springing and center lines and set off the required opening and rise, as A B C. Make C D equal to O A; now put a pin in each of these points as shown at C D D and lap the string around the pins. Now remove the pin from C and put your pencil inside of string and draw the inner curve A B C. For the outer curve set off the width of the Arch, as A F B F and C G. Make G E equal to O F and put the pins in E E G. Lap the string around as before and remove the pin from G and draw the outer curve F F G. To joint this Arch, divide the inner curve into the required number of parts and draw lines from the points D D to each part, as shown at FIG. 3. Now take any radius and draw the Arcs, as x x, then again take any radius from x x and draw the Arcs, cutting each other at C. Now draw the joints through the different points, as shown in figure.

It will perhaps require a little practice to draw this Arch, but it is a simple way of making a true Elliptic, and will be found very useful in other parts of this book.

FIG. 1

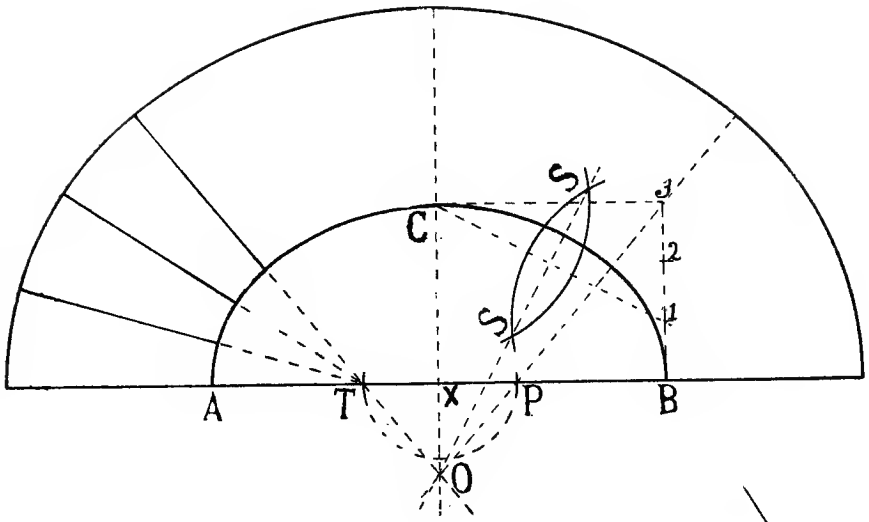


FIG. 2

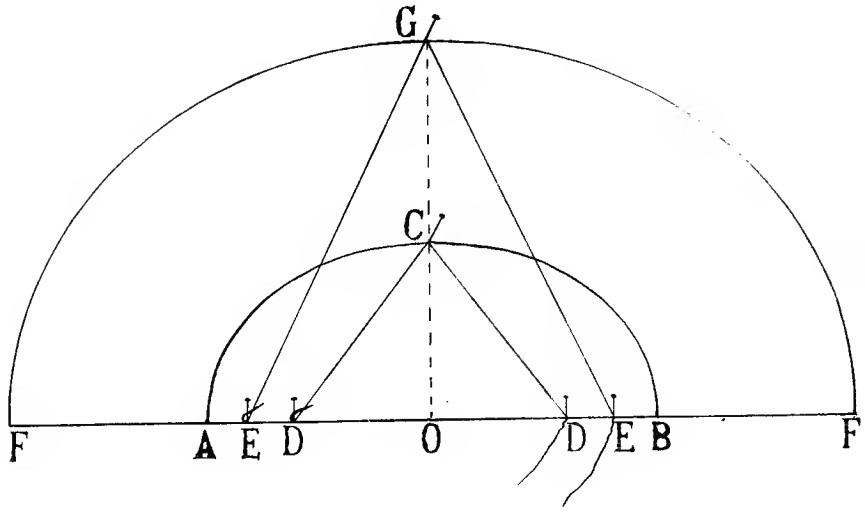
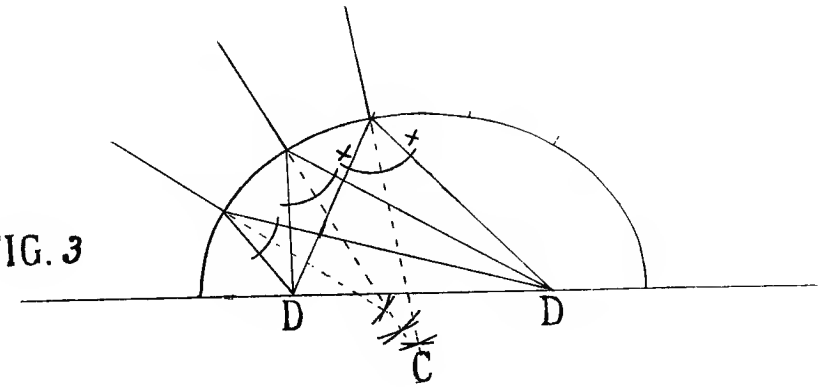


FIG. 3



GOTHIC ARCHES.

THE Four-Centered or Tudor Arch, FIGS. 1 and 2, has two of its centers in or near the spring, and two others far below it. To make FIG. 1 to a given opening, draw the springing line and mark off the opening and width of Arch, as A B C D; now draw the perpendicular lines B E C E, then take C B for the radius and draw the Arcs, cutting E E. Now divide the opening into four equal parts and draw lines through E F E H, and E E F H will be the four centers from which to draw the Arch. The lines through E F E H show where the different curves meet and also the points from which the Arch is jointed.

FIG. 2 has the opening and rise given. To find the centers from which to strike it, draw the springing and center lines and mark off the required opening and rise, as A B 3; divide the rise into three equal parts, as 1 2 3, then draw the lines A 4 2 4 and 4 3. Now draw the line 3 5 square to 4 3 and make 3 O and A O equal to C 2; then take any distance greater than the half of O O and draw the Arcs, cutting each other at X X. Now draw a line through X X cutting the line 3 5, then draw the line S S parallel to the springing line, and take C 5 for the radius and draw the curve, cutting the line S S. Now take C O for the radius, and draw the curve, cutting the springing line at O V, and S S O V will be the four centers from which to draw the Arch. The joints are struck from the different centers, as shown in figure.

FIG. 1

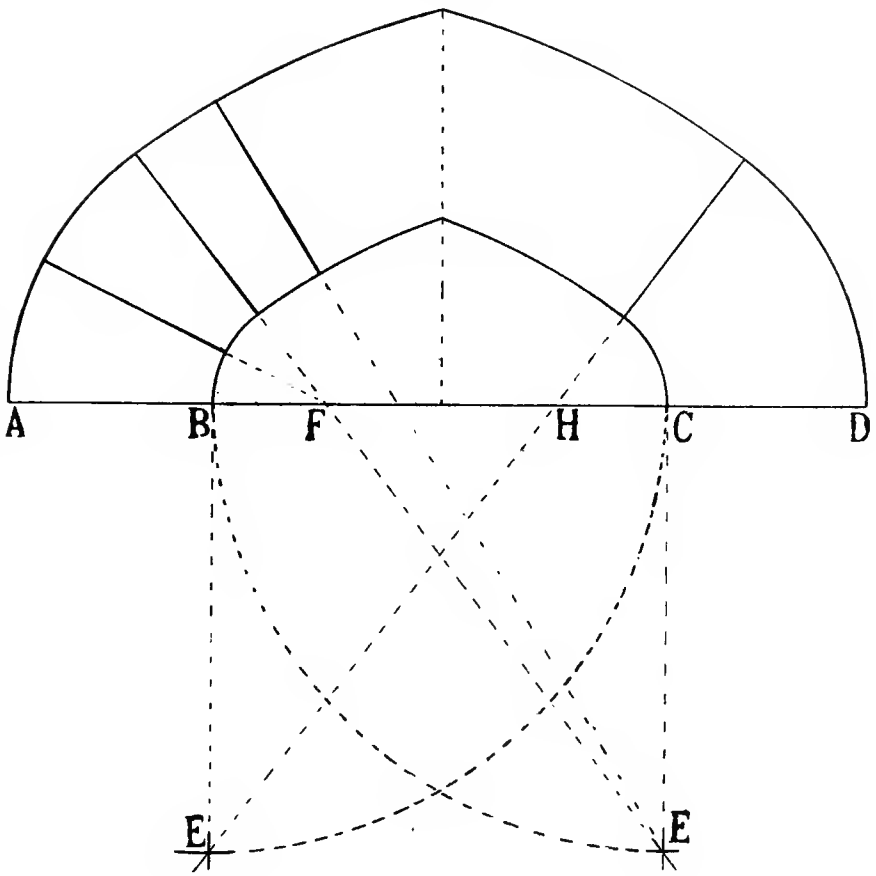
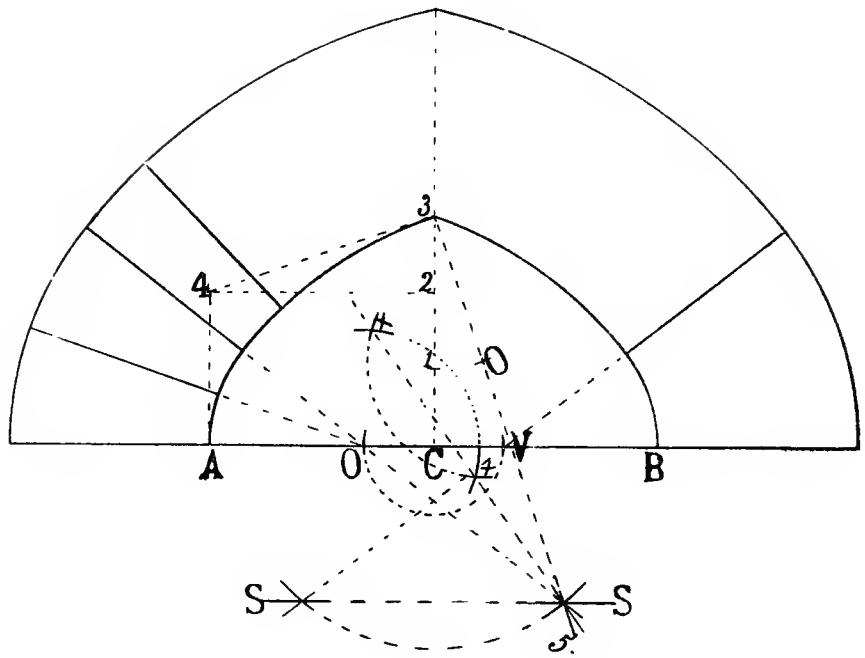


FIG. 2



STRAIGHT ARCHES.

TO make **FIG. 1,** draw the lines **x x x x** parallel to each other, and to the required height of the Arch, and **B B** to the required opening, then take **x x** for the radius and draw the Arcs, cutting each other at **C.** Now divide the Arch into the required number of parts and draw the joints from the point **C.**

FIG. 2 is an elevation, showing the construction lines of a Straight Arch, with plumb joints. **FIG. 3** is a plan of the Top Bed, showing the shape of the stones on the top. **Nos. 1 2 3 4** are the Bed Moulds, as taken from **1 2 3 4** in plan, showing the lines of the Top and Bottom Beds of the Stones, and **A B C D** are the Face Moulds, as taken from elevation.

FIG. 1

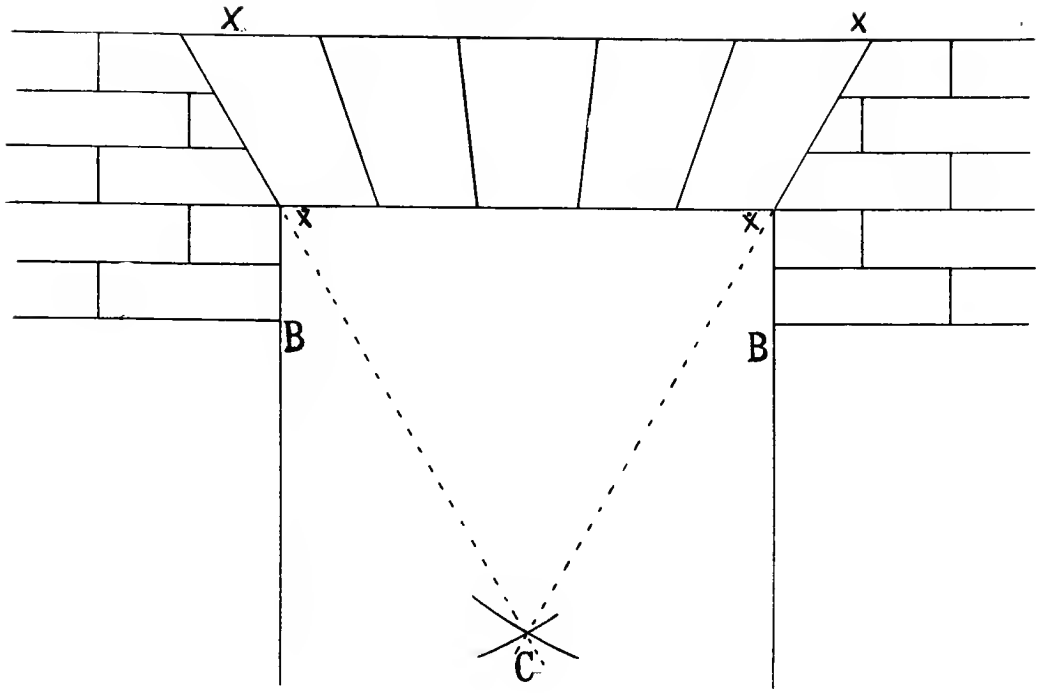


FIG. 2

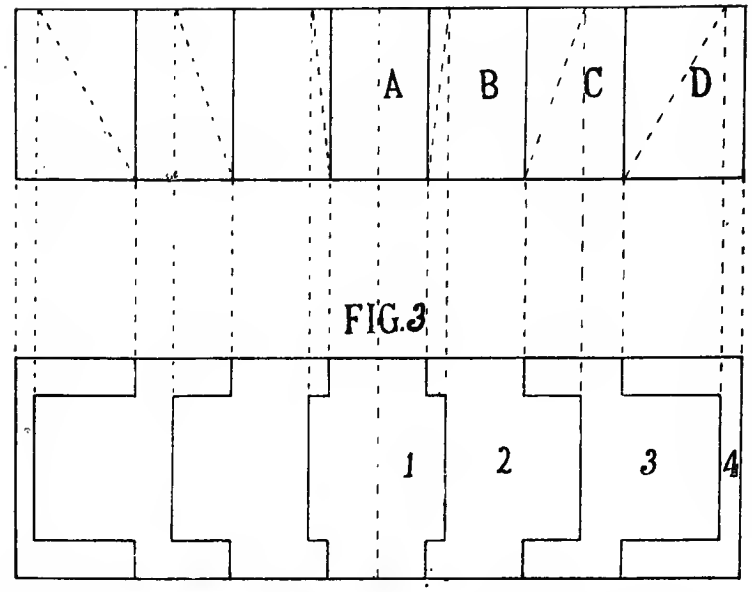
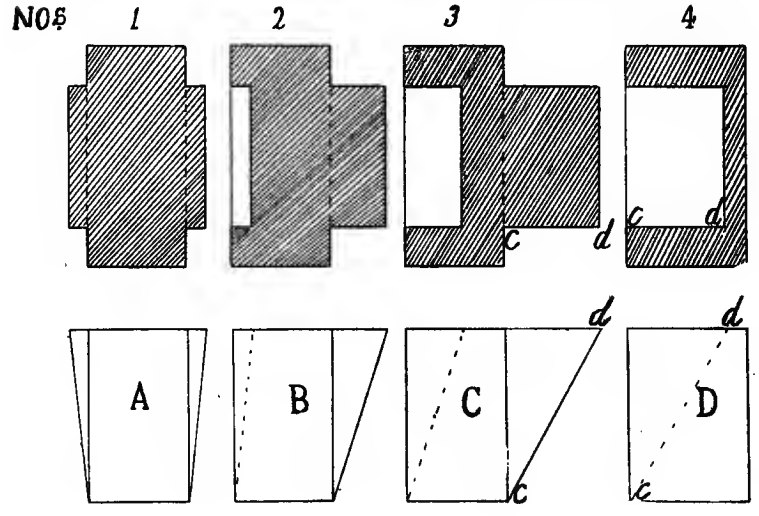
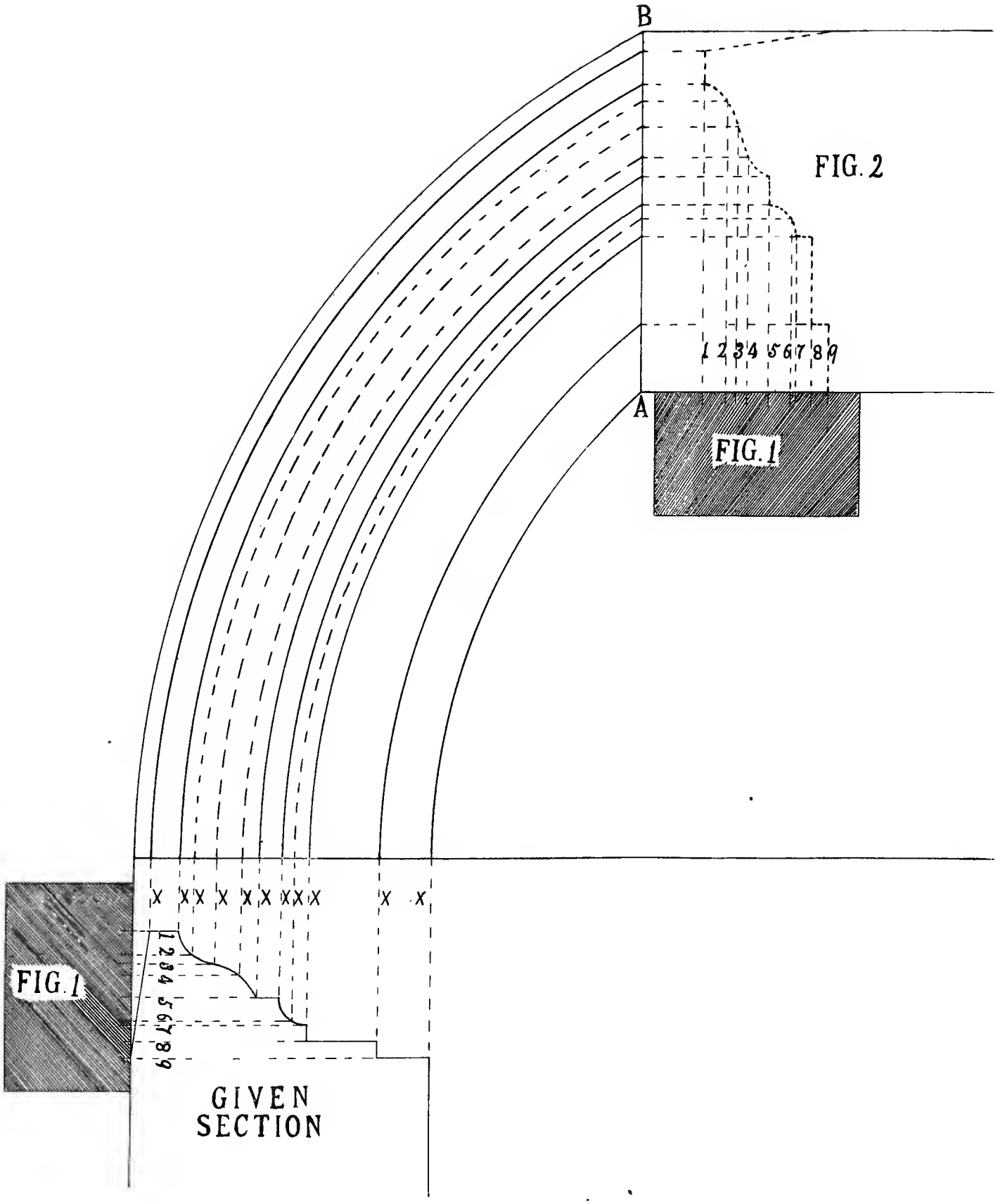


FIG. 3



A Method, showing how to make, from a given section, a Mould to fit a mitre joint of a Gothic Arch.—First, draw the given section and divide it into any convenient number of parts and draw perpendicular lines, as **X X X X X,** &c. from the different points to the springing line ; then draw horizontal lines, as **1 2 3 4 5,** &c. from the different points to either the top or bottom of the given section ; in this case they are drawn to the top. Now find the center from which the Arch is struck and draw lines from the different points at springing line, to the line **A B;** then again draw them square from **A B.** Now carry **1 2 3 4,** &c. from given section to the top or bottom of **FIG. 2** and draw the perpendicular lines **1 2 3 4,** &c., and through the points of intersection of the different lines draw the developed Section Mould, **FIG. 2.**

The best way to carry a number of points from one line to another is by marking them on a piece of card or paper, then carry the paper with the different points marked on it from one line to another, as shown at **FIG. 1.**


B
FIG. 2
1 2 3 4 5 6 7 8 9
A
FIG. 1
FIG. 1
1 2 3 4 5 6 7 8 9
GIVEN
SECTION

RAKING MOULD.

THIS is the design of a Cornice, on a square plan, having part of the moulding level and part inclined, as occurs in the pediment of a building. In this drawing, FIG. 1 is the square section. With this mould given we have to find the right section of the ogee in the pediment. First draw the given section, FIG. 1, and from FIG. 1 draw the lines A B C D and 1 2 3 4 5 6 7 to the required rake, and parallel to each other. Now, from the different points where 1 2 3 4 5 6 7 touches the ogee at FIG. 1, erect the perpendicular lines o x x x x x x x. Then carry o x x x x x x x from FIG. 1 to the line A B, as shown at FIG. 2, and from these points draw perpendicular lines, touching the lines, 1 2 3 4, &c. Now draw a dotted line to the different points, and the Raking Mould, FIG. 2, is complete. To find the section through the mitre, as FIG. 3, draw the lines 1 2 3 4, &c. square from the mitre line, and carry o x x x x, &c. from FIG. 1 to FIG. 3, and draw perpendicular lines from these points to 1 2 3 4, &c.; then draw a dotted line to the different points, and you have a mould that fits the mitre.

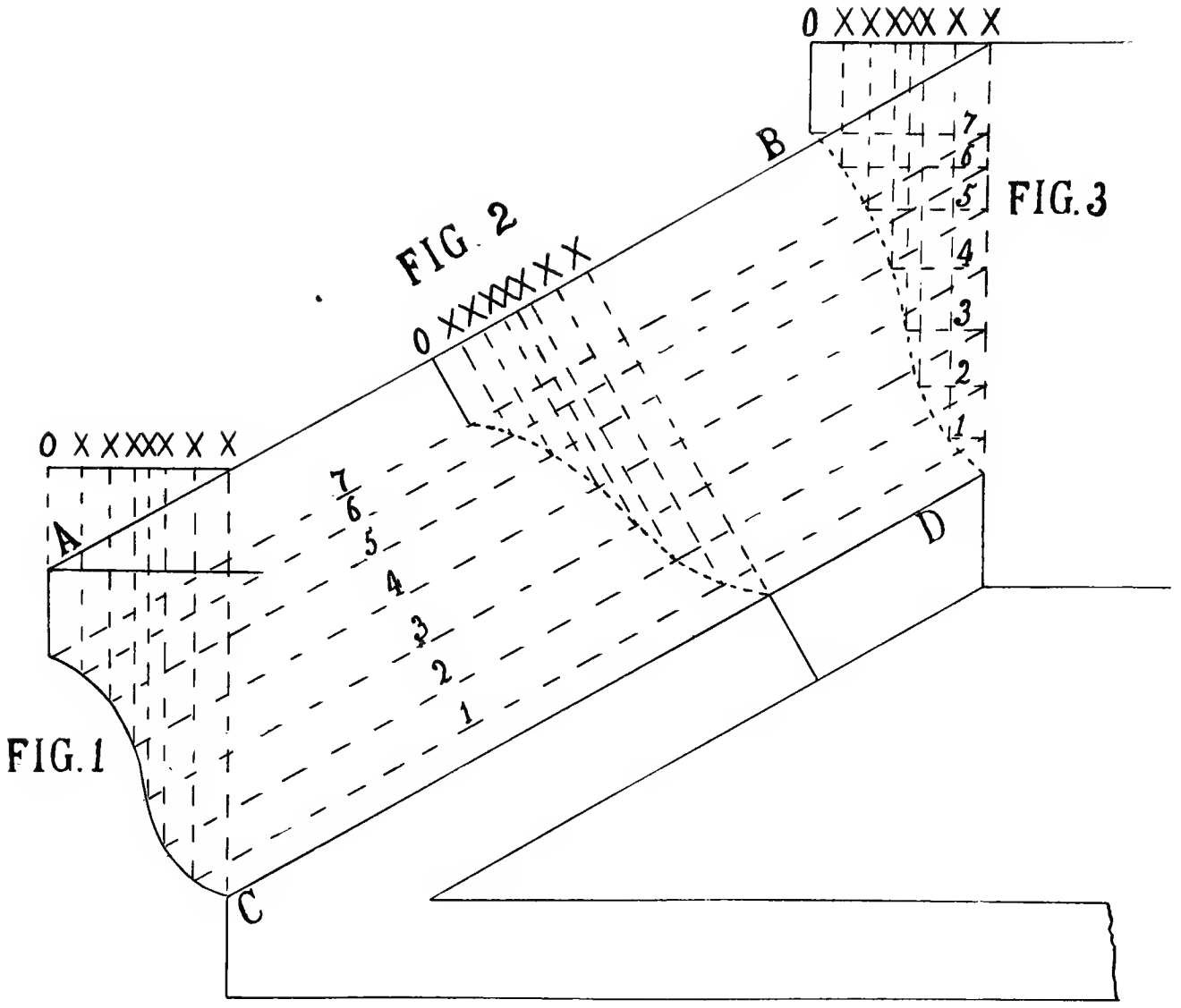
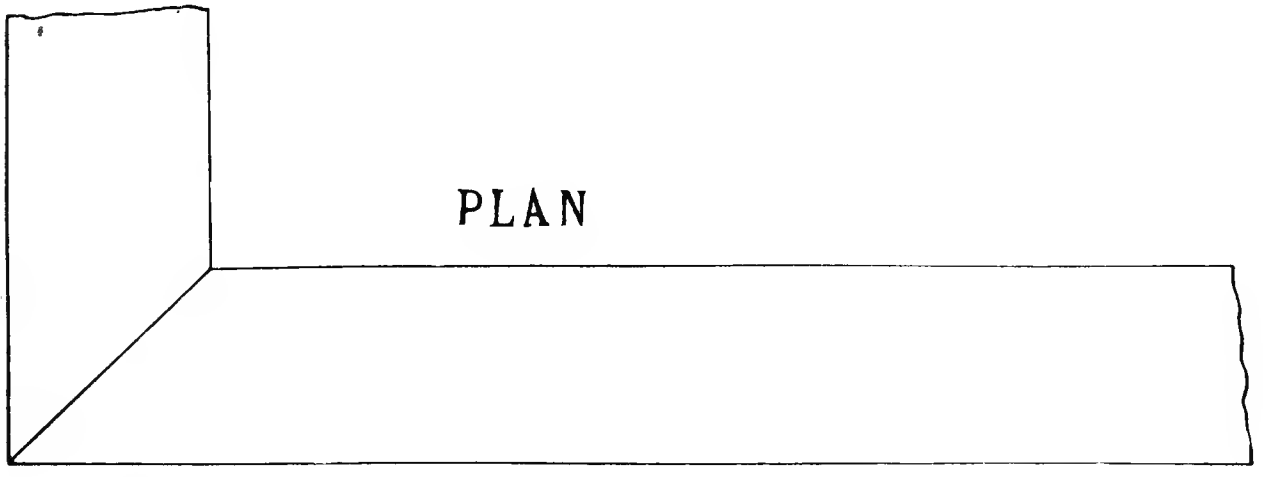


FIG. 1

FIG. 2

FIG. 3



PLAN

RAKING MOULD.

THIS is the design of a Cornice, on an angle plan, having part of the moulding level, and part inclined. In this drawing, FIG. 1 is the square section. With this mould given, we have to find the right section of the ogee in the pediment. First draw the given section, FIG. 1, and divide it into any convenient number of parts, and draw perpendicular lines, as O X X X X X X X; now draw the plan to the required angle; make A B C D E F equal to the projection of the given section, then carry O X X X X, &c. from FIG. 1 to the plan, and draw lines from these points to the line E B. Now draw perpendicular lines from the different points at E B to the lines 1 2 3 4 5 6 7 8, &c. at FIG. 1; then trace a line through the different points of intersection, and you have a line showing the mitre, and also the points from which to draw the raking lines used in making FIGS. 2 and 3, which are both made in the same way as explained on Page 7.

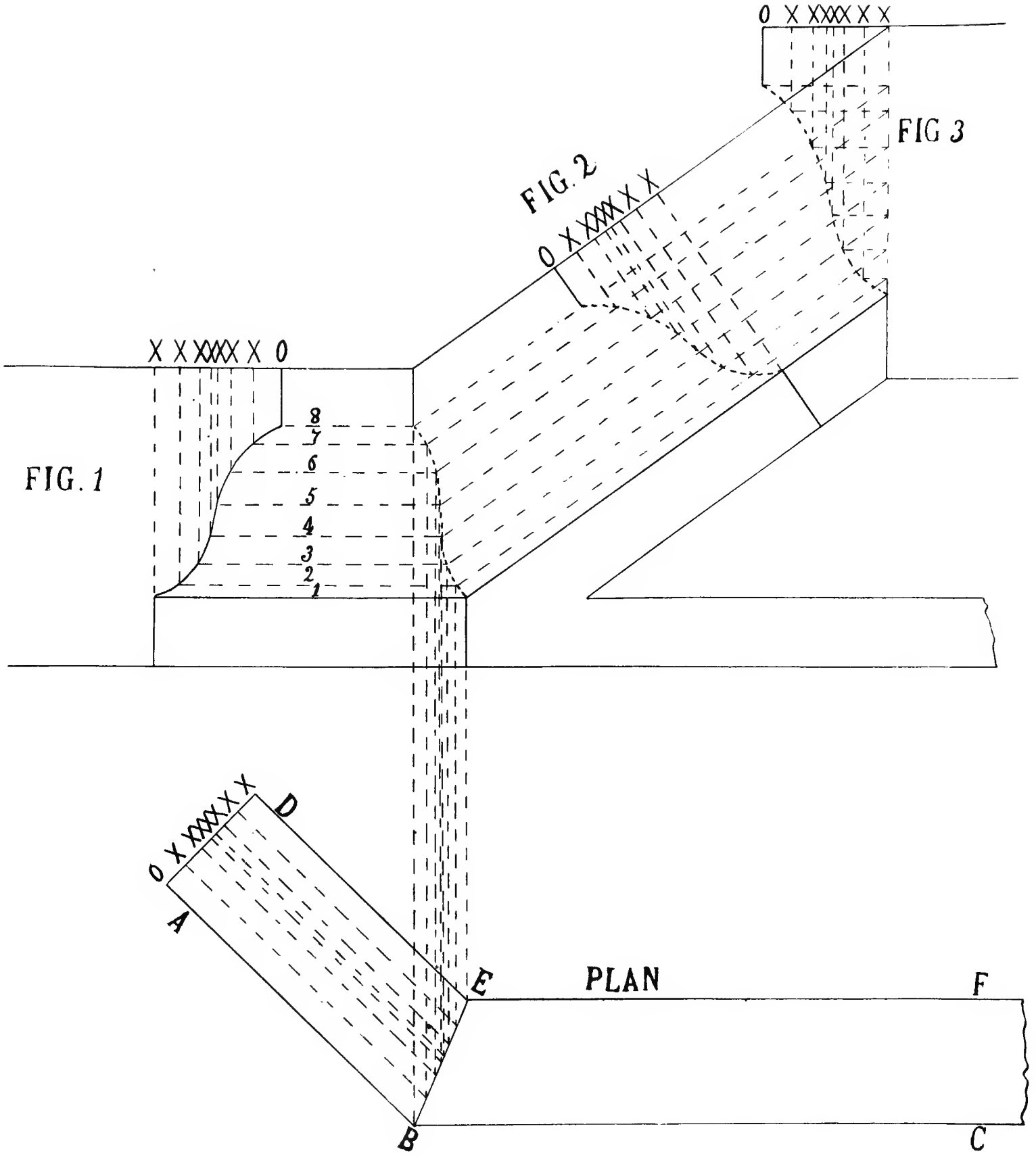


FIG. 1
FIG. 2
FIG 3
PLAN
A
B
C
D
E
F
1
2
3
4
5
6
7
8

FIGS. 1 and 2 are problems often used in Stone-cutting. FIG. 1 is a method showing how to increase or diminish the projection of any given section, and also how to find the line that will mitre the different projections. FIG. 2 is a method showing how to make a Cant Mould, or a mould to apply to the beveled end or side of a stone.

To diminish the projection of any given section, first draw the given section, then draw the lines A B C D equal to the projection of the given section, and B E D F equal to the projection of the diminished section. Now divide the given section into any convenient number of parts, and draw the perpendicular lines 1 2 3 4 5 6 and the horizontal lines C d e f g h i j. Now carry C d e f g h i j from given section to the line D F and draw perpendicular lines from these points; then from the different points at B D draw lines to intersect the perpendicular lines as from x to e, &c., and through the different points thus obtained, draw the diminished section. To find the line that will mitre two different projections.—Let us say one section has 6″ projection and the other 3″. Measure 6″ and 3″ or 9″ and 4½″, or any distance in proportion to the difference of projection.

The use of the Cant Mould, FIG. 2, in the cutting of any Polygon shaped stone, such as Octagon Caps and Bases, or any stone with beveled ends or sides, where a joint mould can be applied, does away with many hours unnecessary labor. To make it, first draw the square section, then draw the lines A B C D equal to the projection of the square section, and B D to the required angle. Now divide the square section into any convenient number of parts and draw the lines 1 2 3 4 5 6 from square section to the line B D; then draw the perpendicular lines d e f g h i j from the different points of square section to the line A B. Now draw the lines x x x x x x square to B D and carry A b c d e f g h i j from square section, and draw perpendicular lines from these points to the lines x x x x, &c. Then through the different points thus obtained, draw the Cant Mould. This system applies to any kind of a section mould. In this case the mould is made plain, so that the lines used in its construction will be clear and distinct.

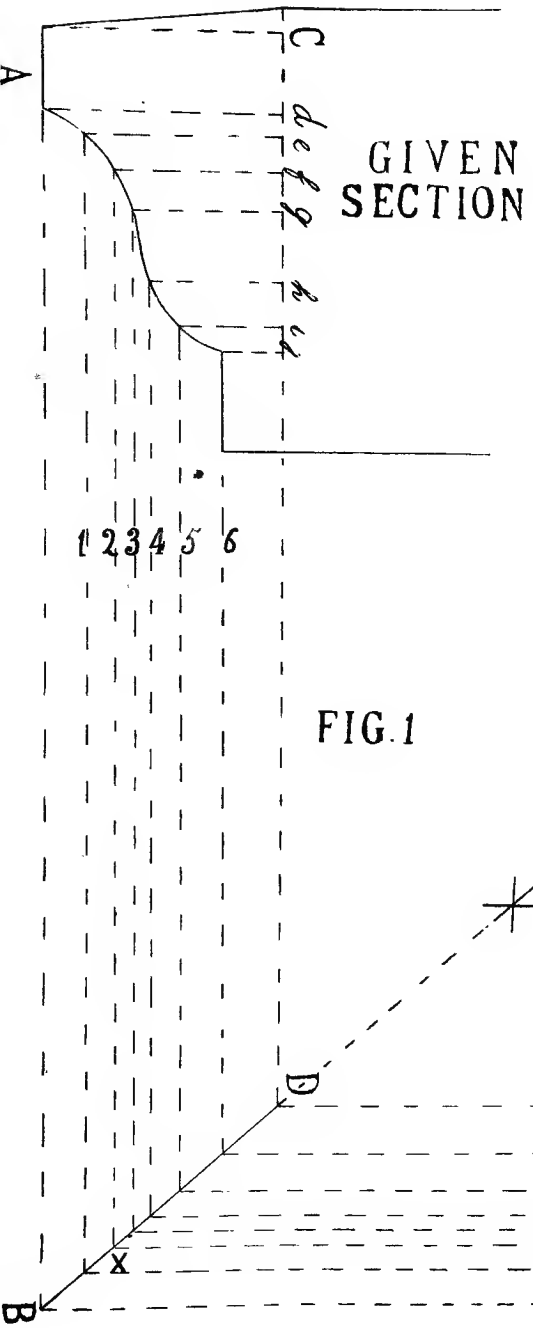
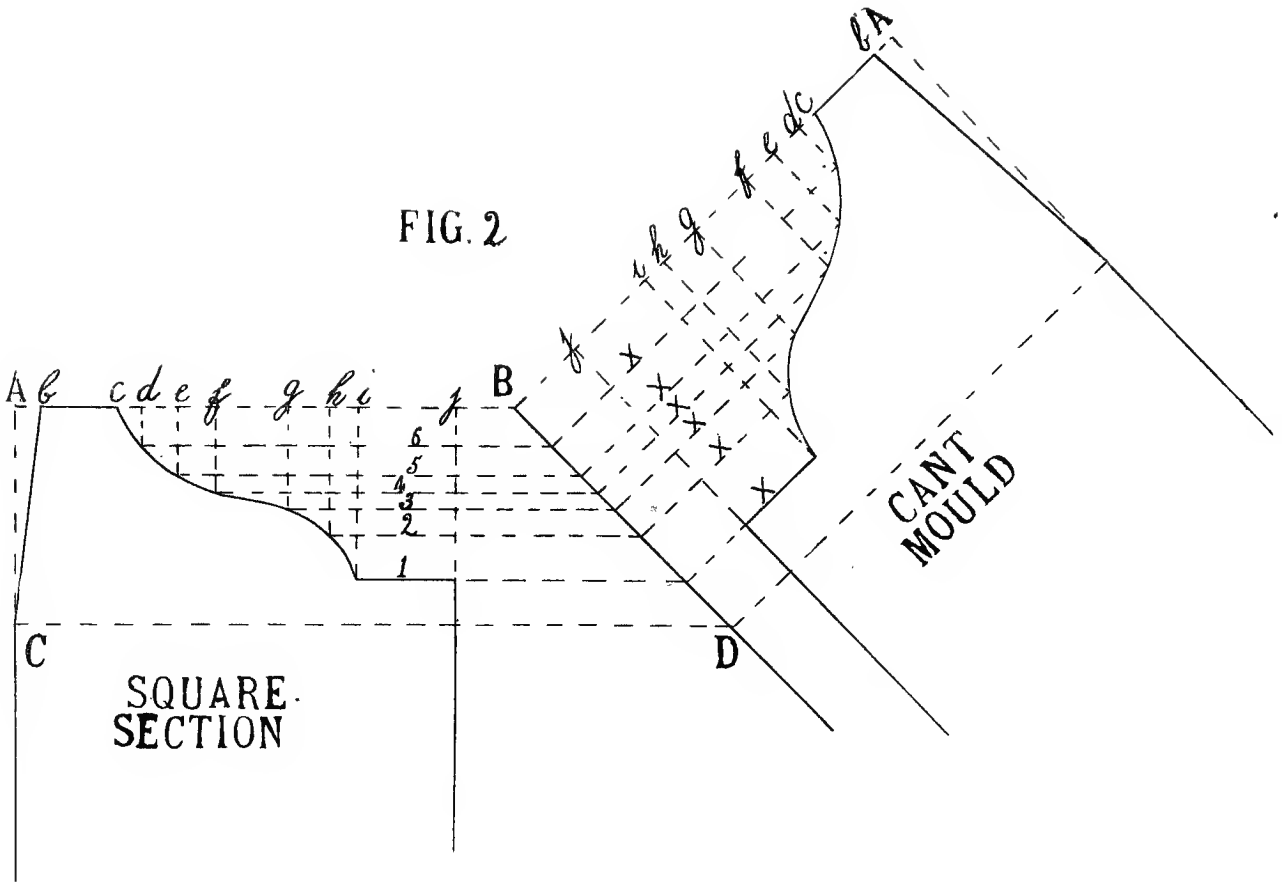
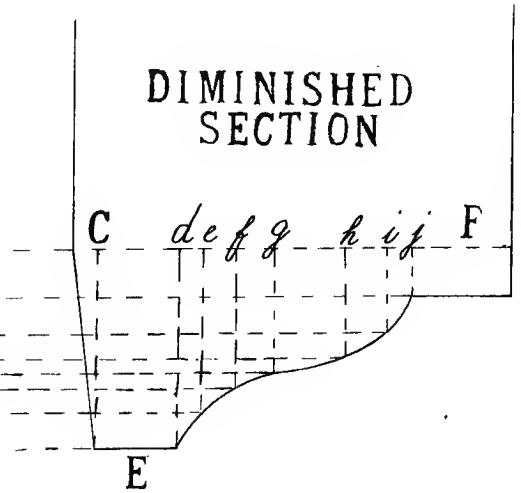

A
C
GIVEN
SECTION
1 2 3 4 5 6
B
D
X

FIG. 1

FIG. 2


A
B
C
D
SQUARE
SECTION
CANT
MOULD


DIMINISHED
SECTION
C
F
E

OBLIQUE OR SKEW ARCH.

TO make the Moulds for this Arch, let FIG. 1 be the plan and FIG. 2 the elevation of a Semi-circular Arch. Now what we want to do is to make FIG. 2 big enough (when cut) to cover the plan, FIG. 1. Now draw FIG. 2 and divide it into as many parts as stones required.—In this Arch we have five stones. Then draw the lines A B C D, at FIG. 1, parallel to each other and to the required angle and thickness of the Arch. Now draw the perpendicular lines a b c d from FIG. 2 to FIG. 1, and we have the plan and elevation from which to make the different moulds. Now let us develop one-half of the Soffit, and make the moulds to be applied to the soffit of the stones. Divide the soffit of FIG. 2 into any convenient number of parts, as 0 1 2 3 4 5, and draw perpendicular lines from these points to the plan. Now draw a line, as X X at FIG. 3, and carry 0 1 2 3 4 5 from FIG. 2 to the line X X, and draw perpendicular lines from these points. Now draw horizontal lines from the different points of plan to the different points at FIG. 3, as from 5 to 5, 4 to 4, and so on, and through the different points thus obtained draw the curved lines 5 X and 5 0. To make the Joint Moulds, make a b at Nos. 2 and 3 Joint Moulds equal to the width of the arch stones, as a b at FIG. 2; then make b o x a 2 at No. 2 Joint Mould equal to b o x a 2 in plan; then make b c d a 4 at No. 3 Joint Mould equal to b c d a 4 in plan. That completes Nos. 2 and 3 Joint Moulds. No. 1 is taken from the plan. Now work one of the stones, FIG. 4.—Cut a bed, then apply templet taken from FIG. 2, and cut the soffit, then reverse the templet and cut the other bed. To make the springer, we would now apply No. 1 Joint Mould to the bottom bed, and No. 1 Soffit Mould to the soffit; then No. 2 Joint Mould to the top bed. Now cut the face to the lines, and the top or crown to the templet taken from the top of FIG. 2. If both faces of the Arch are cut there will be no necessity to hand the stones, but if only one face is cut, care must be taken in handing them.

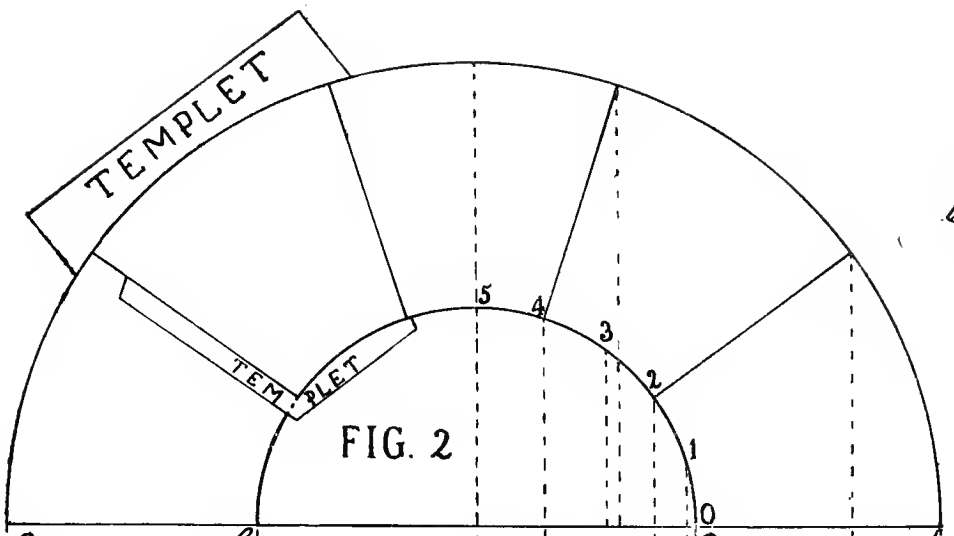


FIG. 2

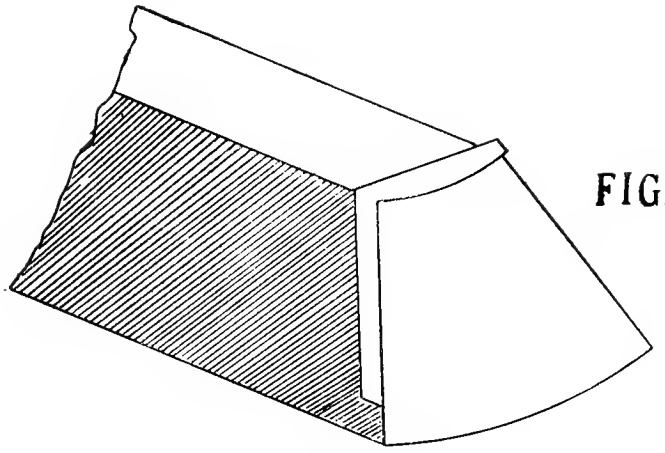


FIG. 4

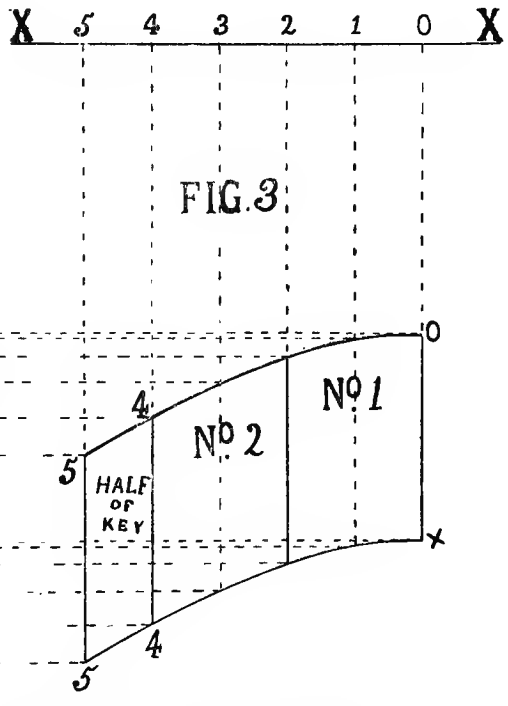


FIG. 3

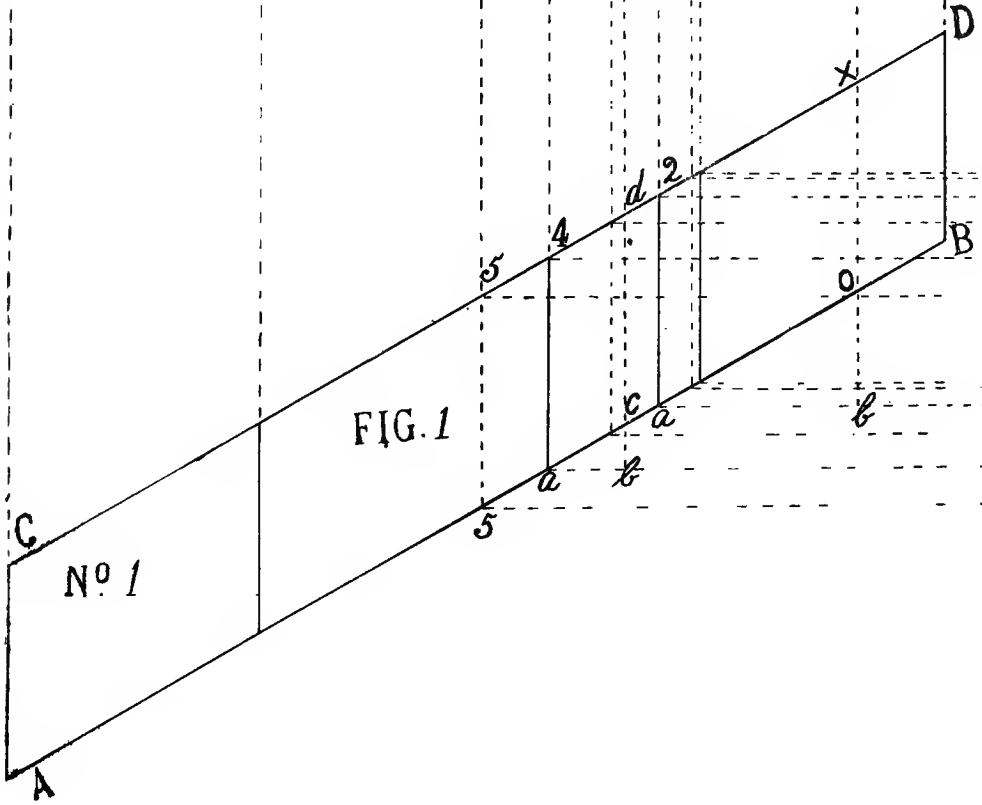
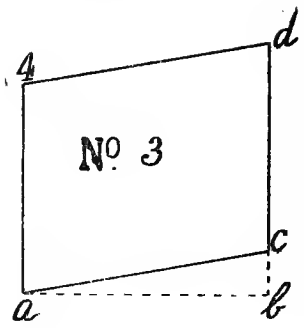
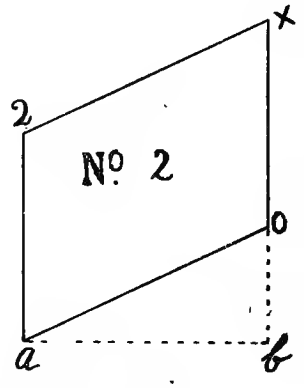


FIG. 1

SOFFIT MOULDS

JOINT





MOULDS

OBLIQUE OR SKEW ARCH.

TO make the Moulds for this Arch, first draw a plan and elevation to the required size, as FIGS. 1 and 2. Make A B C D at FIG. 1 parallel to each other, and to the required thickness of the Arch. Now mark off the required opening and width of arch stones, as A E F B, and make A C E G F H B D parallel to each other and to the required angle. Now draw perpendicular lines from the different points of plan to the springing line of FIG. 2, and take X e for the radius and draw the semi-circle e f; then take X a for the radius, and draw the semi-circle a b. Now divide the Arch thus drawn, into the required number of parts, and draw the joint lines from the center X; that finishes the outside face lines. Now draw the inside face lines.—Take O g for the radius and draw the semi-circle g h, then take O c for the radius, and draw the semi-circle c d. Now draw the lines 1 2 3 4 through soffit and top bed, parallel to springing line, and from the different points thus obtained, draw the inside joint lines from the center O. That finishes the plan and elevation, and shows the lines of the outside and inside faces of the Arch. To cut this Arch, make face moulds the full size of the stones, as shown at FIGS. 3 4 5, taken from elevation. Now let us make FIG. 4.—Cut the faces to the required thickness, as taken from plan, and apply the face mould to the outside face, and draw the lines A B C D E F. Now square a draught through the corner, at O, and take the line O E on the inside face, out of twist with the line A on the outside face; then draw the inside face lines, set the mould to the line E and the point O; now cut to the lines. Take notice that the lines A B C D are the outside face lines, and E F G H the inside face lines. If only one face of this Arch is cut, care must be taken to hand the stones; if both faces are cut, there is no need to hand them, because the outside and inside face lines are the same. If this Arch was turned around, what is now the outside face would be the inside face. The method used for cutting this Arch does away with bevels and templets, and is a true and simple way to cut this kind of Arch.

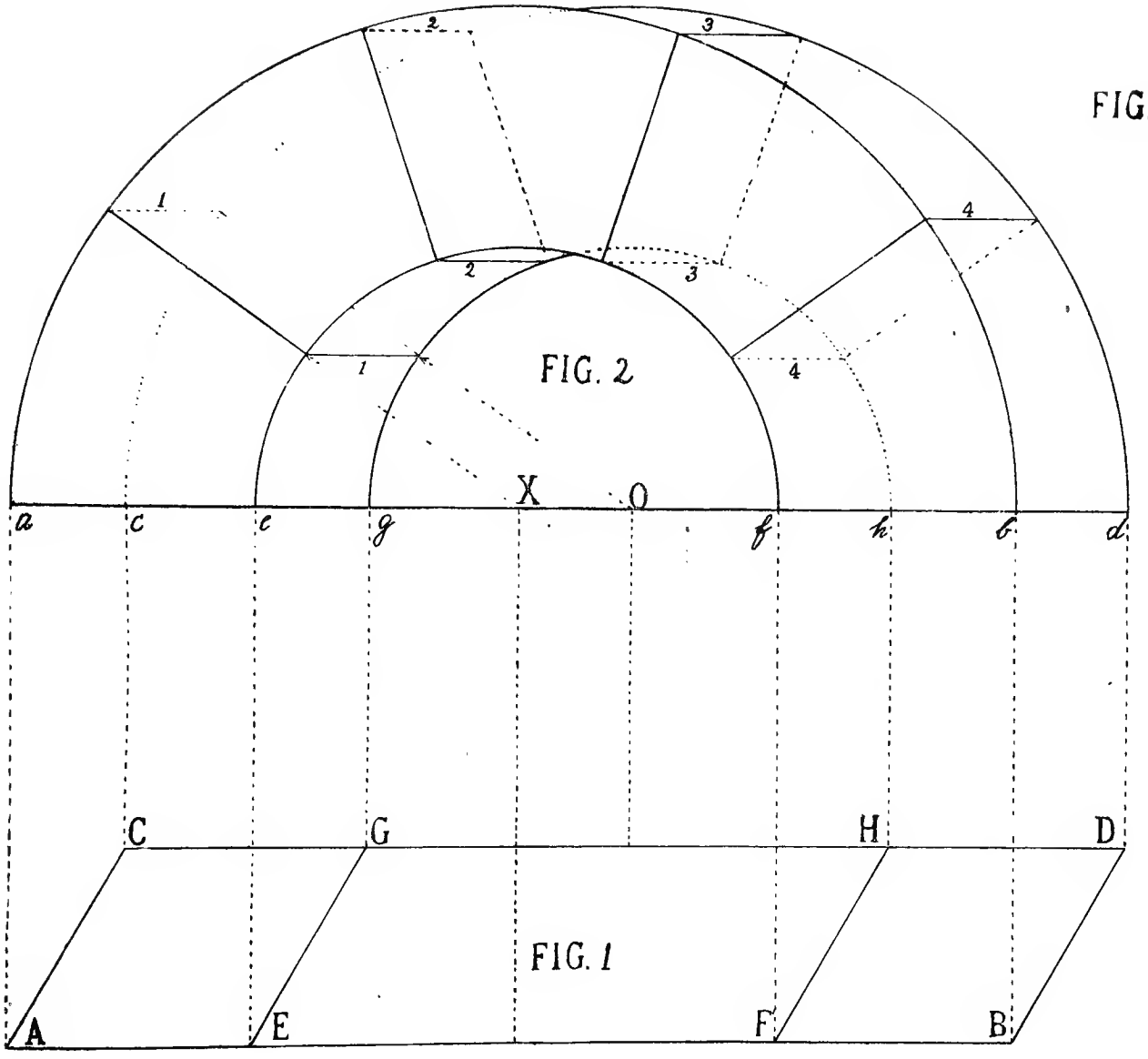


FIG. 2

FIG. 1

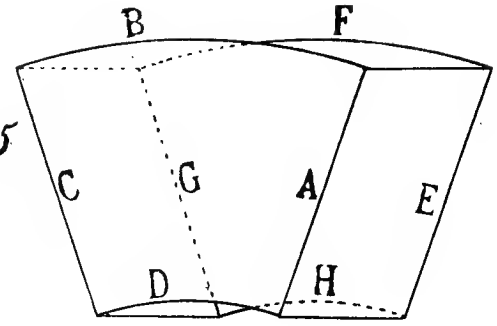


FIG. 5

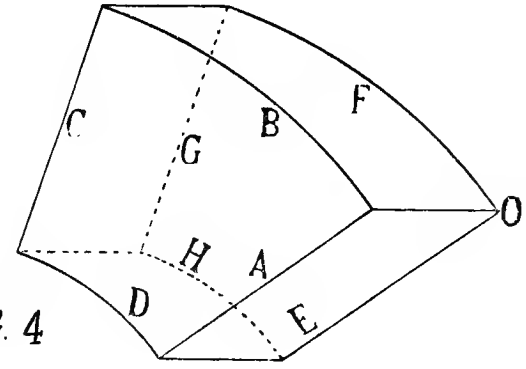


FIG. 4

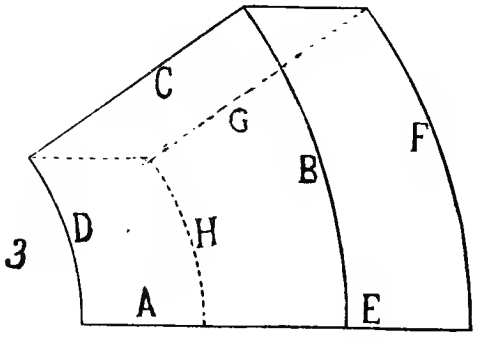


FIG. 3

BATTERING ARCH.

TO make the Moulds for this Arch, let FIG. 1 be the elevation, and FIG. 2 be a section through X X. Now draw the lines 1 2 3 4 from the different points of FIG. 1 to the face line of FIG. 2, and we have the points from which to make the Joint Moulds. To make them, draw a line, as O E, then make E I C G A O equal to the width of the Arch Stones, as shown at B B in elevation. Now, for No. 1 Joint Mould, make A B equal to A B at FIG. 2. For No. 2 Joint Mould, make C D G H equal to C D G H at FIG. 2, and for No. 3 Joint Mould make E F I J equal to E F I J at FIG. 2. Now make a face mould the full size of one of the Arch Stones, as B B D H and we have the required moulds. Now let us make the springer.—Cut a face good enough to work from, then mark on the face mould, and cut the stone the same as any other common arch stone; when this is done, mark No. 1 Joint Mould on the bottom bed, as shown from B to A, at FIG. 3. Now draw a square line through soffit from the point A, as shown from A to C at at FIG. 3; then mark No. 2 Joint Mould on the top bed, setting the points C D to the soffit and the line A C; now cut the face.

Another way to cut this Arch is to make templets, as shown at elevation; then instead of cutting the face of the stone first, cut a bed, and apply the templets to cut the soffit and top bed, then apply the Joint Moulds, as explained above.

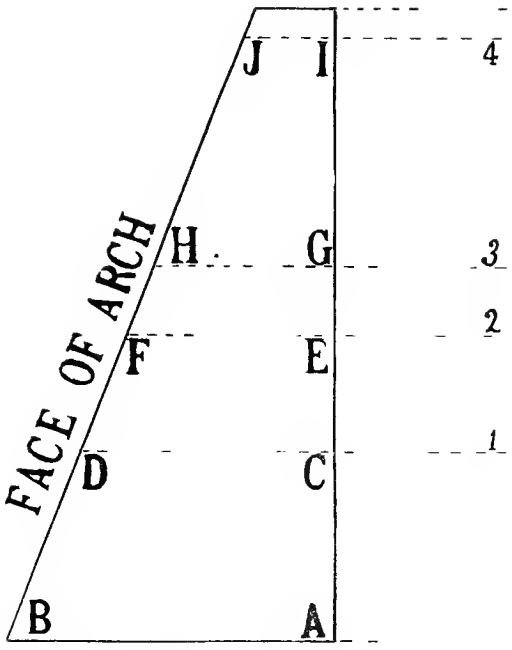


FIG. 2

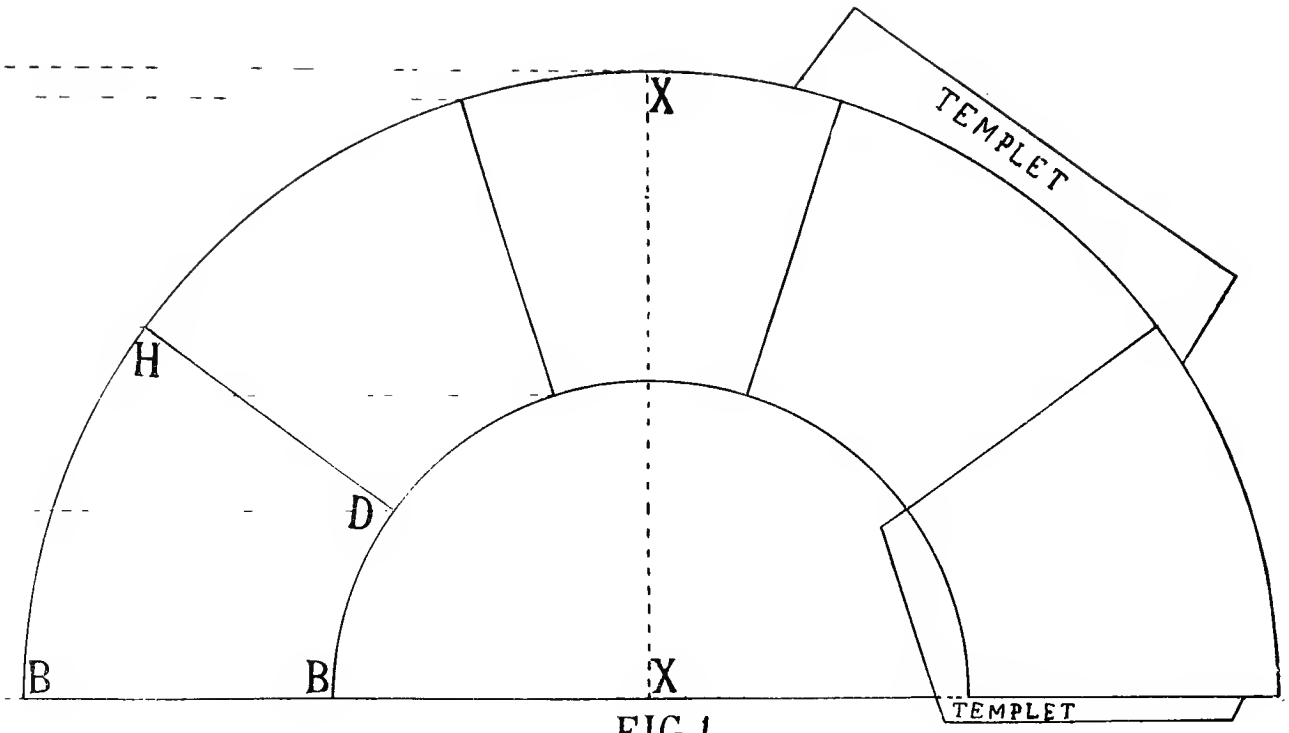
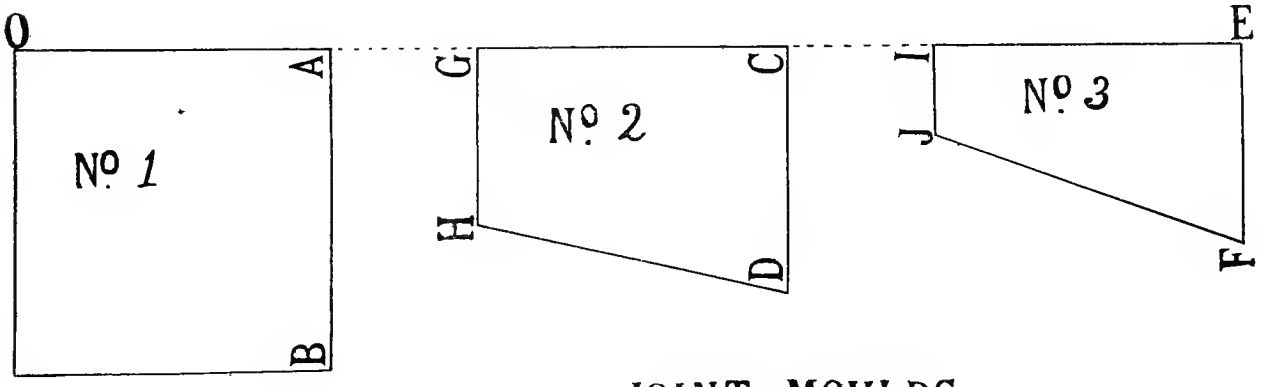


FIG. 1



JOINT MOULDS

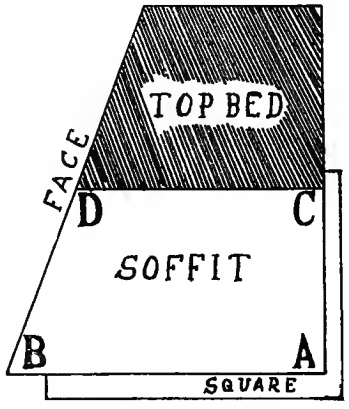


FIG. 3

ARCH THROUGH AN ARCH.

LET us suppose FIGS. 1 and 2 to be the entrance to two long corridors or passages, and FIG. 3 to be an archway through FIGS. 1 and 2. Now what we want to do is to make the required moulds to be used in the cutting of FIG. 3. Now draw, to the required size, as much of FIGS. 1 and 2 as will be required to get the lines of FIG. 3; then draw FIG. 3 to the required size, and divide the soffit and top bed into any convenient number of parts, as 0 1 2 3 4 5 6 7. Now draw horizontal lines from these points to the soffit of FIGS. 1 and 2, and from the points where these lines touch the soffit lines, draw the perpendicular lines 0 1 2 3 4 5 6 7. Now draw a line, as X X, and carry the points 0 1 2 3 4, &c. from around the soffit and top bed of FIG. 3 to the line X X, and from these points draw horizontal lines to the different points of the perpendicular lines, as from 7 to 7, 6 to 6, 5 to 5, &c.; then through the different points thus obtained, draw the curved line A B; that completes the development of the top bed of FIG. 3. The development of the soffit is made in the same way—only work from the soffit, instead of from the top bed, as shown by the lines. Now let us make a face mould the full size of one of the arch stones.—Draw lines on it parallel to the springing line, as shown on face mould. The line marked No. 2 would be parallel with the springing line if the face mould was in the same position as No. 2 stone in elevation. The line marked No. 3 would be parallel to the springing line if the mould was in the same position as the key-stone; this will be readily seen by the lines across the stones in elevation. Now cut the development of soffit and top into pieces at the different joints and we have the required moulds. Let us cut one of the stones—say the springer. Cut a face good enough to work from, then mark on the face mould and cut the joints, soffit and top bed, the same as any other common arch stone. Now draw No. 1 top bed mould on the top bed, and No. 1 soffit mould on the soffit, then cut to the lines with straight draughts parallel to the springing line. All the stones are cut in the same way—only apply the different soffit and top bed moulds to the different stones, and cut the face with draughts parallel to the springing or the lines on the face mould. Another way to cut this Arch is to make templets, as shown at elevation, then instead of cutting the face to apply the face mould, cut a bed first, and apply the templets to cut the soffit and top, then apply the soffit and top bed moulds, as explained above.

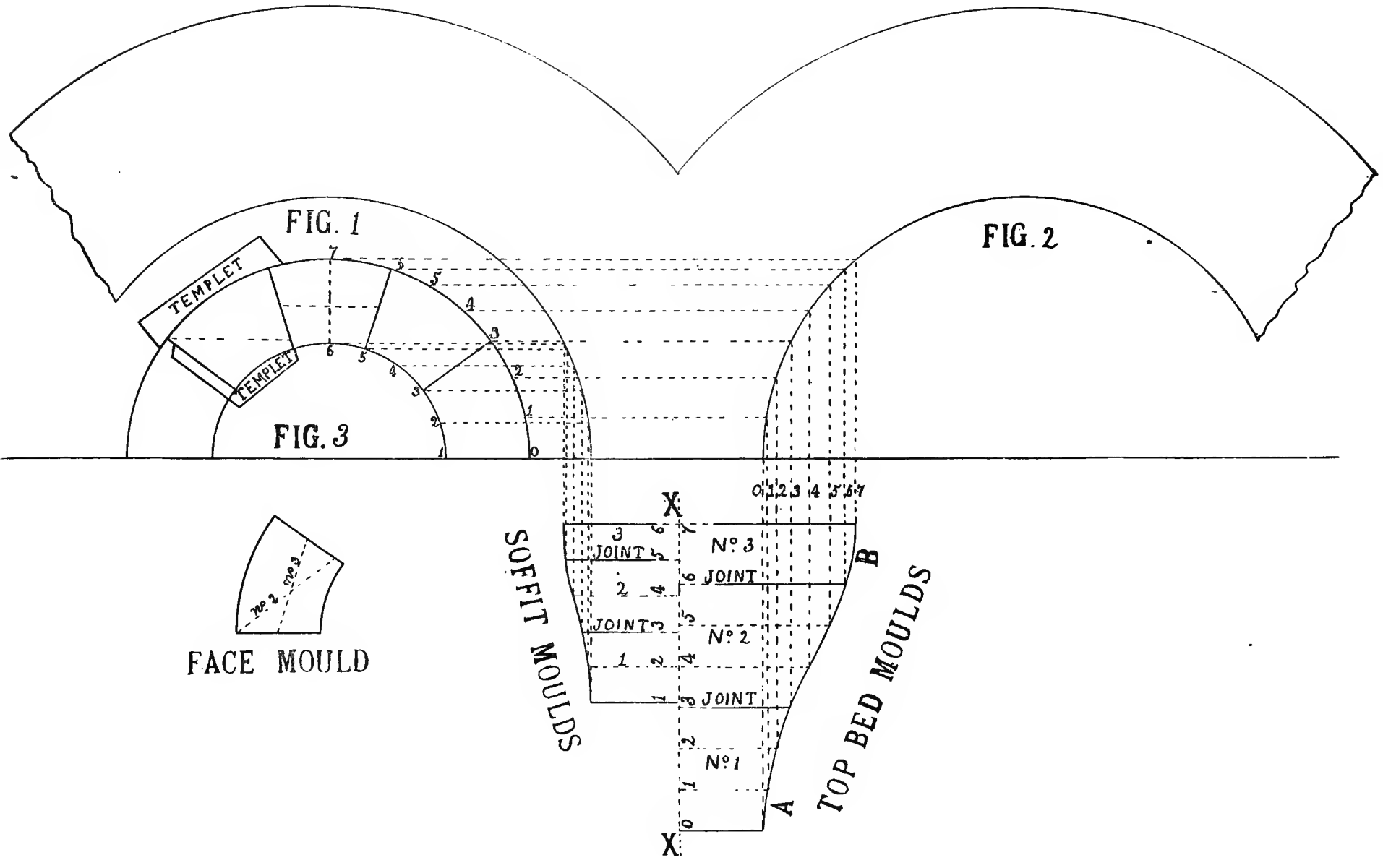


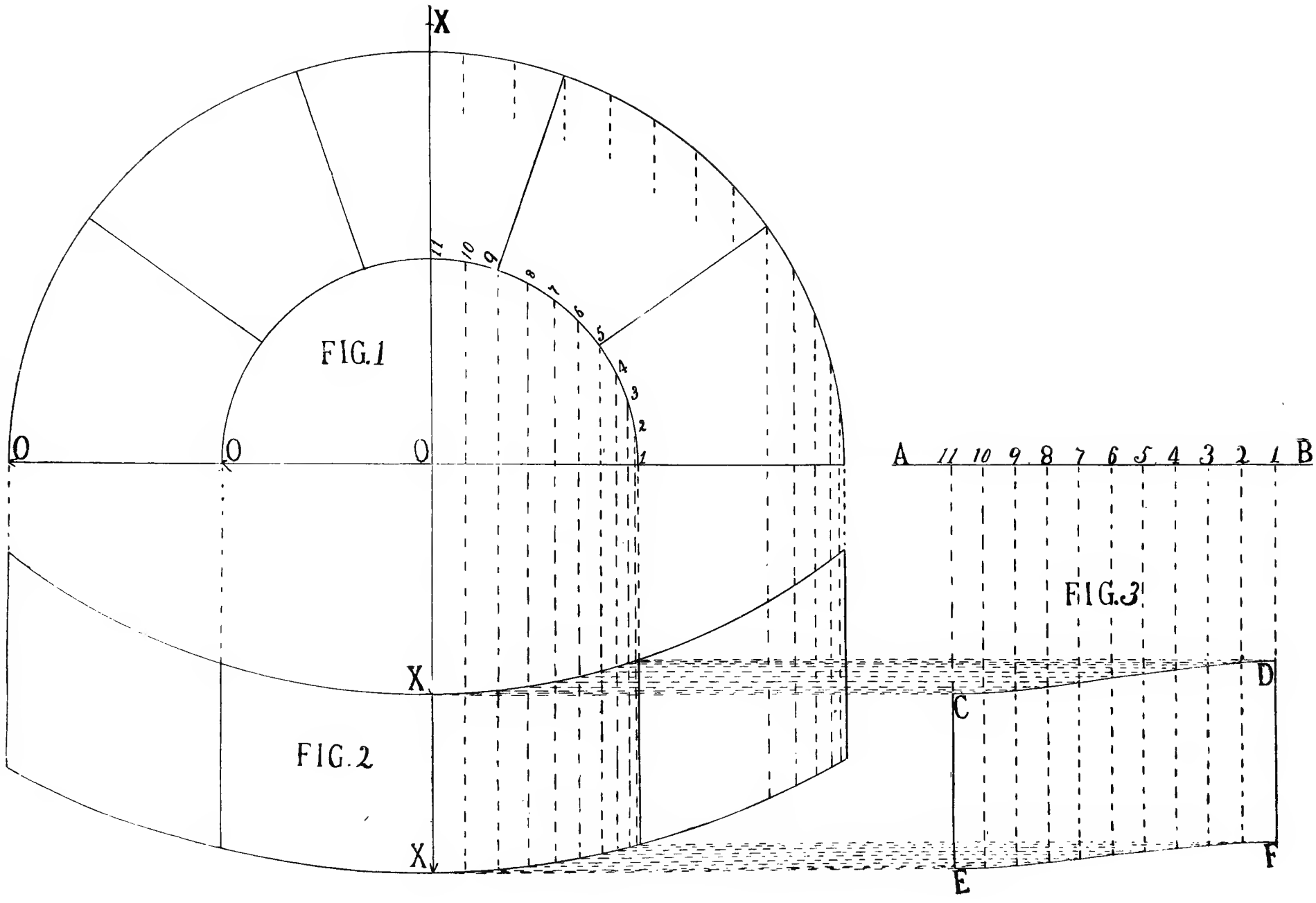
FIG. 1
TEMPLET
TEMPLET
FIG. 3
FIG. 2
FACE MOULD
SOFFIT MOULDS
TOP BED MOULDS
X
X
A
B
JOINT
JOINT
JOINT
JOINT
Nº 3
Nº 2
Nº 1

CYLINDRICAL ARCH.

TO make the working drawing of this Arch more easily understood, we will first draw a plain plan and elevation, and development of one-half of Soffit.

This is a common semi-circular Arch, on a circular plan. To draw it, find the radius of the elevation, as O O O at FIG. 1, and draw it to the required size. Then find the radius of the plan, as X X X, and draw it to the required size. Now let us develop one-half of the soffit.—Divide the soffit into any convienent number of parts, as 1 2 3 4 5 6, &c. and draw perpendicular lines from these points to the plan. Now draw a line, as A B at FIG. 3, and take 1 2 3 4 5 6, &c. from elevation, and mark them on the line A B, and from these points draw perpendicular lines. Then draw horizontal lines from the different points of 1 2 3 4 5 6, &c. in plan, to the perpendicular lines 1 2 3 4 5 6, &c. at FIG. 3. Now draw the curved lines C D E F through the different points, and we have a mould to be applied to the soffit of the Arch. The development of the top of the Arch is made in exactly the same way—only divide the top into a number of parts, as shown by the dotted lines around the top of the Arch, and work from the plan and the top of the Arch.

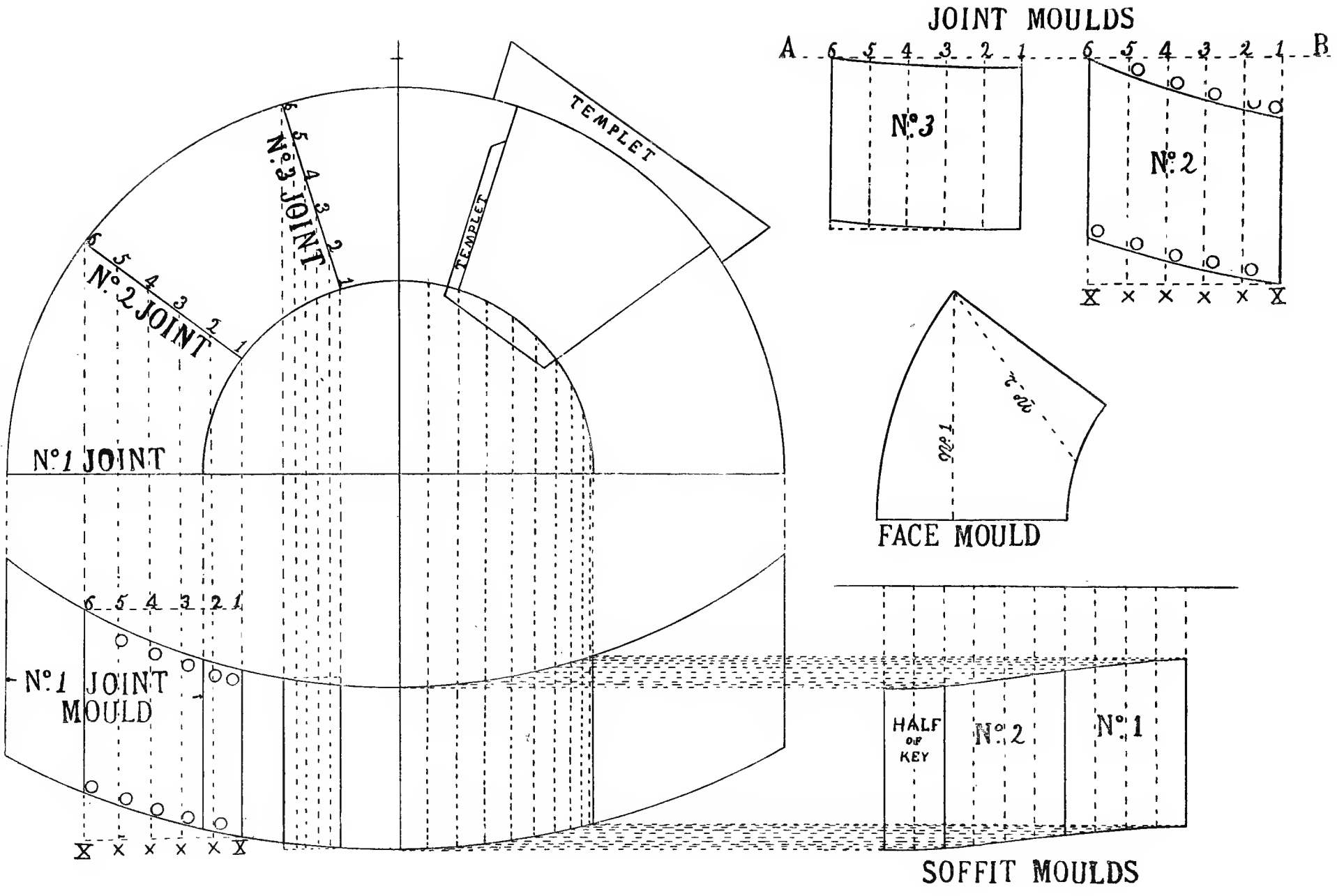
To make the working drawing and moulds, see page 15.


X
11
10
9
8
7
6
5
4
3
2
1
O
O
O
FIG.1
X
X
FIG.2
A
11
10
9
8
7
6
5
4
3
2
1
B
FIG.3
C
D
E
F

CYLINDRICAL ARCH.

TO make the Moulds for this Arch, first draw, to the required size, a plan and elevation, as explained on page 14. Now let us draw the lines from which to make the Joint Moulds. Let us take **No. 2 JOINT** and draw the lines from which to make **No. 2** Joint Mould. Divide **No. 2 JOINT** into any convenient number of parts, as **1 2 3 4 5 6,** and from these points draw perpendicular lines through plan, as **1 X 2 X 3 X,** &c.; then across these lines, draw lines touching the inside and outside lines of plan, as from **X** to **X** and **6** to **1**. Now we have the points from which to make **No. 2** Joint Mould. To make it, draw a line, as **A B,** and carry the points **1 2 3 4 5 6** from elevation, and mark them on the line **A B,** and from these points draw perpendicular lines, as **1 X 2 X 3 X** &c. Now carry **X o x o x o** and **1 0 2 0 3 0,** &c. from the plan, and mark them at the different points of **No. 2** Joint Mould; then draw the curved lines through the different points thus obtained, and **No. 2** Joint Mould is complete. **No. 3** Joint Mould is made in the same way, as will be seen by the figures and lines from **No. 3 JOINT,** corresponding with those at **No. 3** Joint Mould. **No. 1** Joint Mould is taken from the plan. Now develop the soffit and top of the Arch, (as explained on page 14), so as to have moulds to apply to the soffit and top bed of the stones. The next thing to be done is to make a face mould the full size of one of the stones, and draw plumb lines on it, as shown. The line marked **No. 1** would be a plumb line on the springer, and the line marked **No. 2** would be a plumb line on the next stone, if the stone was in its right position. Now let us cut one of the stones, say the springer.—Cut a face so that it will be straight enough to work from, then apply the face mould and cut the joints, soffit and top bed, the same as any other common arch stone; when this is done apply **No. 1** Joint Mould to **No. 1** Joint; then **No. 1** Soffit Mould to the Soffit; then **No. 2** Joint Mould to **No. 2** Joint, and **No. 1** Top Bed Mould to the Top Bed. Now all the lines are on the stone.—Cut to them, and apply the straight edge in the direction of the plumb line on the face mould; all the stones are cut in the same way—only apply the different joint moulds to the different joints, and the different soffit and top bed moulds to the different stones, as shown by their numbers.

Another system for cutting this Arch is to make templets to fit the soffit and top, as shown at elevation; then instead of cutting a face on the stone first, cut a joint first, then use the templet to cut the soffit, then reverse the templet and cut the other joint; now take the templet for the top, and cut the top of the stone; when this is done, use the moulds as explained above.


JOINT MOULDS
A
B
6 5 4 3 2 1
N°3
N°2
X x x x x X
TEMPLET
TEMPLET
N°3 JOINT
N°2 JOINT
N°1 JOINT
N°1
N°2
FACE MOULD
N°1 JOINT MOULD
HALF OF KEY
N°2
N°1
SOFFIT MOULDS

RADIATING ARCH, ON A CIRCULAR PLAN.

TO make the working drawing of this Arch more easily understood, let us first draw a plain plan and elevation. Let FIG. 2 be the plan.—Draw the lines 1 2 from the center X to the required opening, and 3 4 to the required width of the arch stones at the springing line; then draw the perpendicular dotted lines E F G H I J K L from the different points of plan to the springing line. Now draw the elevation, FIG. 1, which, in this case, is elliptic on the outside face, and semi-circular on the inside face. Let us draw the inside face lines first.—Take O E for the radius and draw the semi-circle E L, then take O G for the radius and draw the dotted semi-circle G J; now divide the Arch thus drawn, into the required number of parts, and draw the dotted joint lines. Then use the string method for drawing the elliptic arch, and draw the outside face lines F K H I. Now draw the lines 5 6 7 8 (through soffit) parallel to springing line, and from the points where these lines touch the outside face line, draw the outside face joints, (use the method for jointing the string arch as shown) and from the points where the inside and outside joint lines touch the top of the Arch draw the dotted lines O O O O. That finishes the elevation, and shows all the lines in the Arch.

The inside face of this Arch being a semi-circular one, we have jointed it the same as any other semi-circular arch—from the center from which it was struck; and the outside being elliptic, we have jointed it the same as any other elliptic arch; this is what makes the twist in the joints of this kind of Arch.

To make the working drawing and moulds, see page 17.

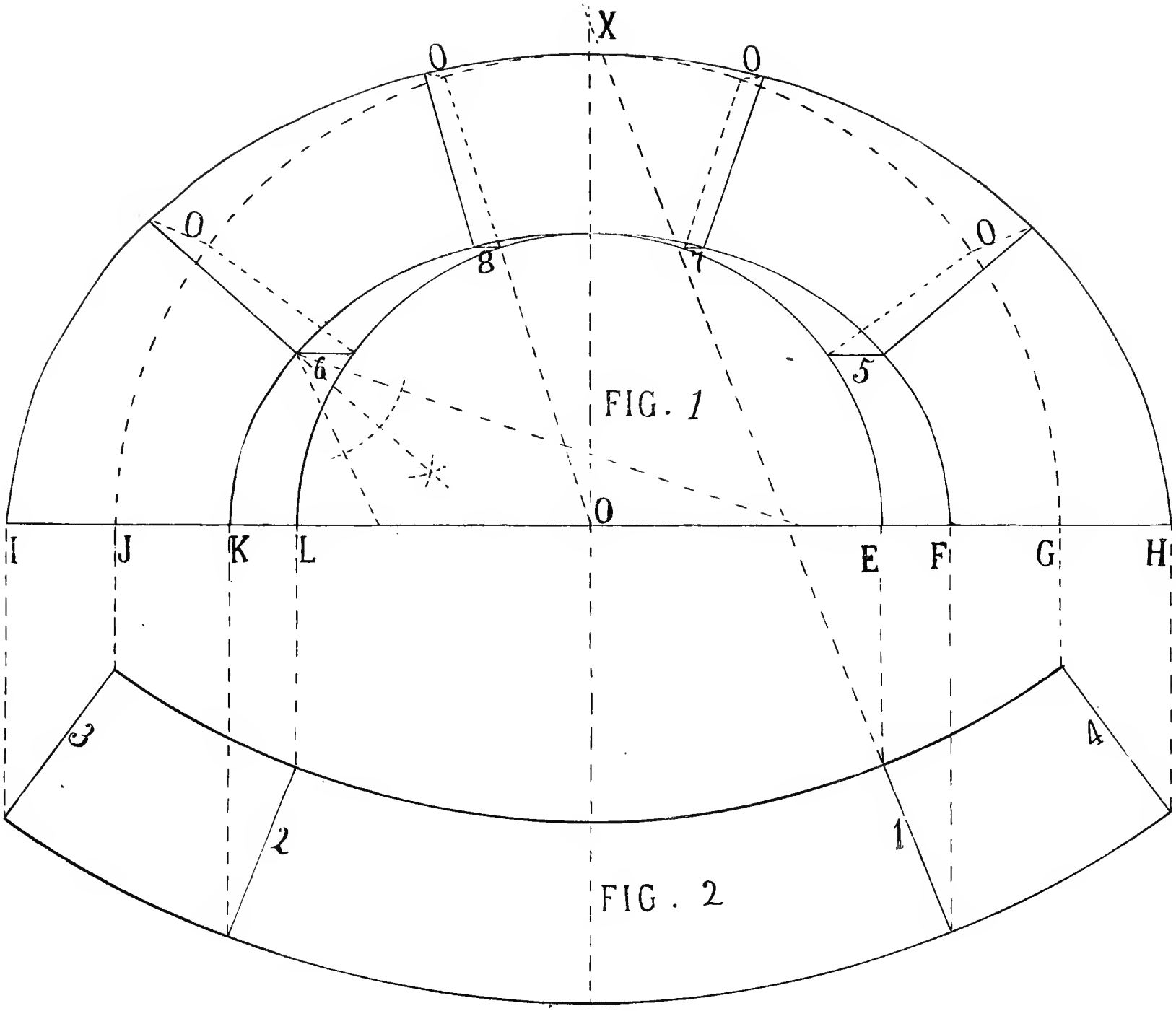
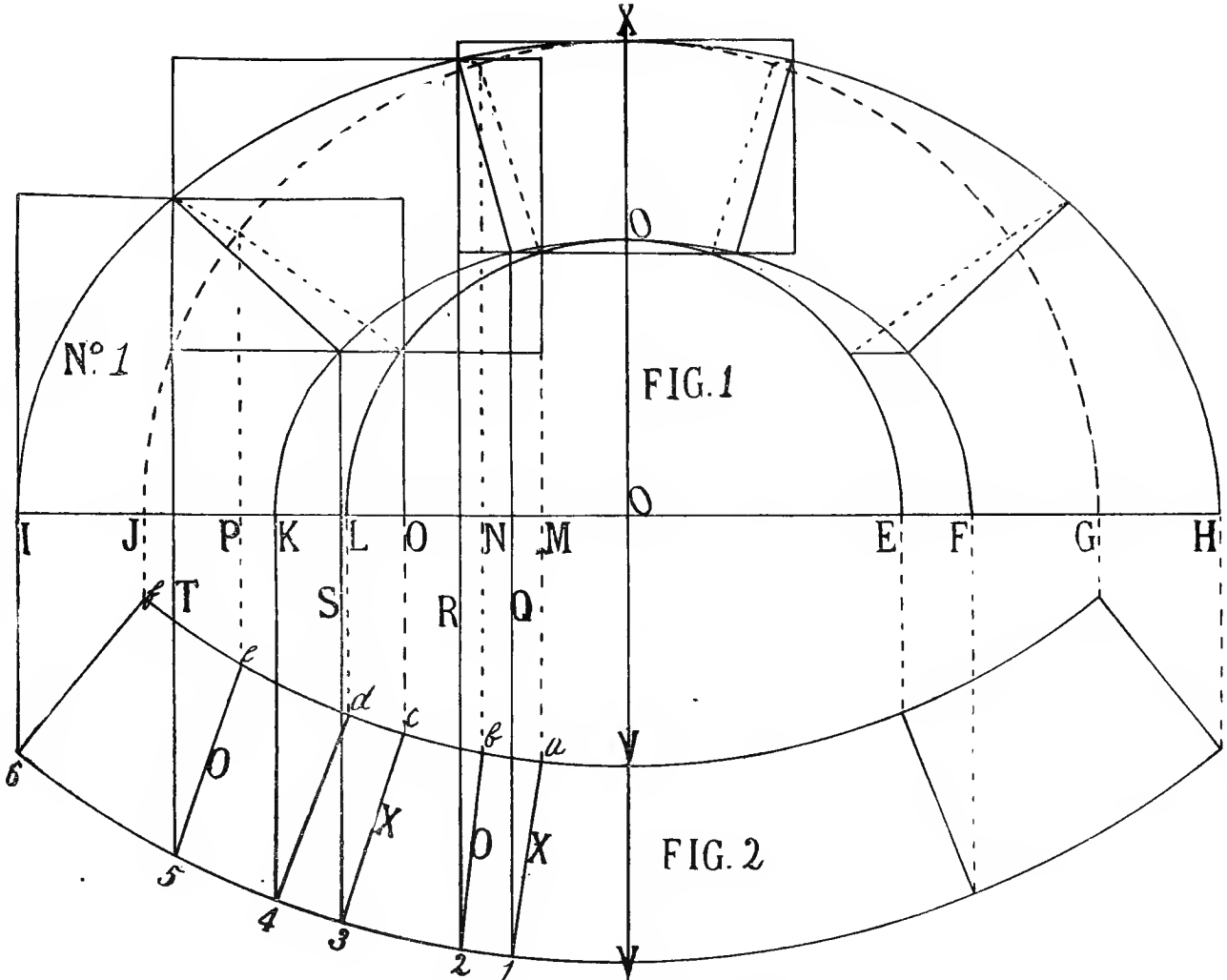


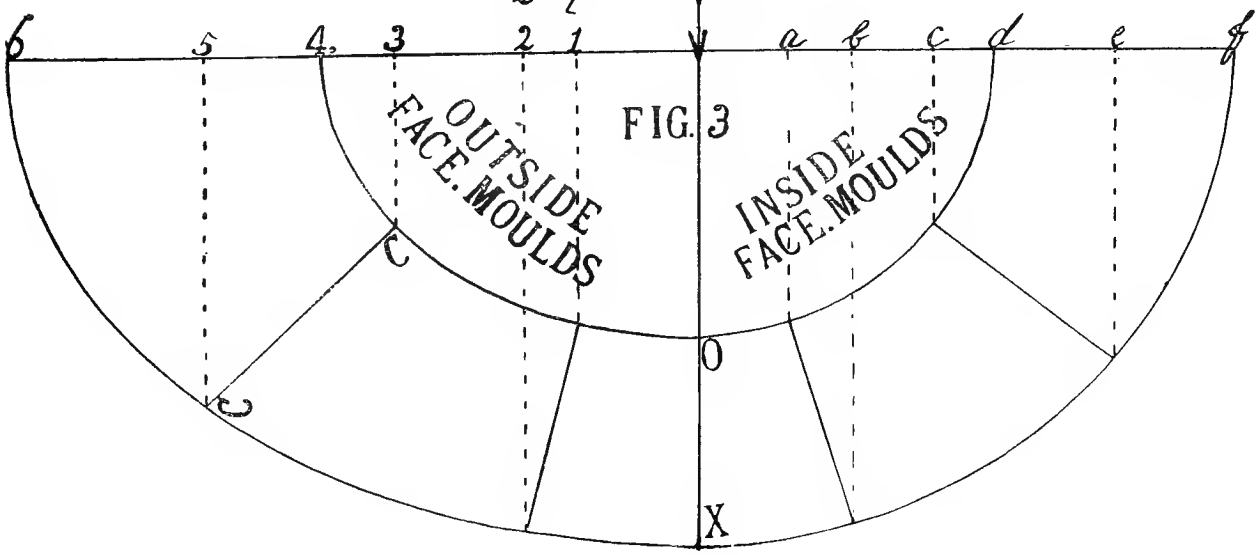
FIG. 1

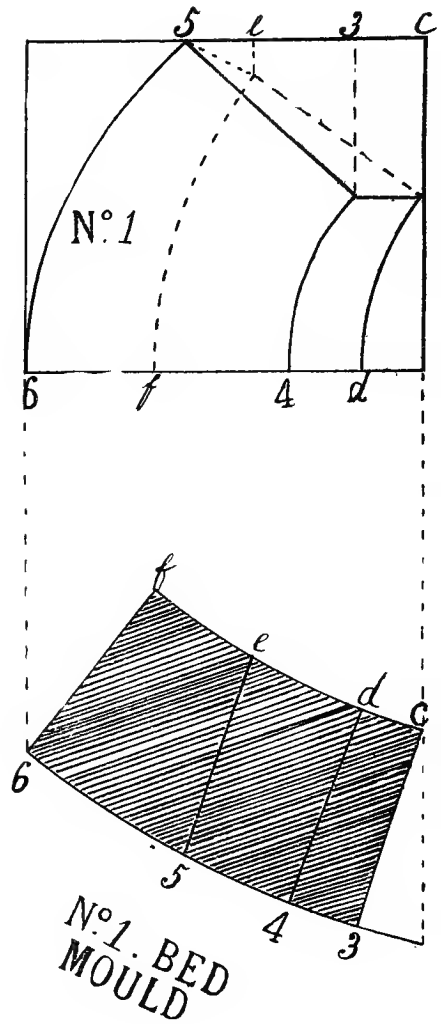
FIG. 2

RADIATING ARCH, ON A CIRCULAR PLAN.

TO make the Moulds for this Arch, first draw a plan and elevation to the required size, as FIGS. 1 and 2 explained on page 16. Now draw the dotted perpendicular lines M N O P from the points of inside joint lines on elevation, FIG. 1, to inside line of plan, FIG. 2. Then draw the perpendicular lines Q R S T from the points of outside joint lines on elevation to outside line of plan, and from the points where these lines touch the inside and outside lines of plan, draw the lines X O X O through the plan. Now let us develop the faces so as to have face moulds to be applied to a circular face. Draw a line as 6 f, FIG. 3, and carry the points V a b c d e f from inside line of plan, and mark V a b c d e f on the line 6 f. Now carry the points V 1 2 3 4 5 6 from outside line of plan and mark V 1 2 3 4 5 6 on the line 6 f, then take the height O O X from FIG. 1 and mark V O X at FIG. 3. Now use the string method for drawing the elliptic arch, and draw the curves O 4 X 6 and O d X f, then draw the dotted perpendicular lines from the different points of the line 6 f, as 3 C 5 C, &c. Now draw the joint lines from the different points, as shown at C C, and we have face moulds that apply to the inside and outside faces. The bed moulds are taken from the plan, as will be seen by the letters and figures on No. 1 BED MOULD, corresponding with those on the plan. No. 1 shows No. 1 stone in square block, as taken from elevation. Let us cut No. 1.—First cut the top and bottom bed to the required height, as taken from elevation, then apply the bed mould and cut the inside and outside faces; now mark the lines off the bed mould on the faces of the stone. Say we put the bed mould on the bottom bed.—Mark the points 6 4 on the outside face and f d on the inside face; now put the mould on the top bed and mark 5 3 on the outside face and e c on the inside face; now draw lines down the face, as shown at e 3, so as to have all the points at which to set the face moulds, then apply the outside and inside face moulds and cut to the lines.


X
O
N° 1
FIG. 1
O
I J P K L O N M E F G H
f T S R Q
e
d c b a
6 5 4 3 2 1
O X O X
FIG. 2


6 5 4 3 2 1 a b c d e f
OUTSIDE FACE MOULDS
INSIDE FACE MOULDS
FIG. 3
C
O
X


5 e 3 c
N° 1
6 f 4 d
f
e
d
c
6
5
4
3
N° 1 BED MOULD

BATTERING ARCH, ON A CIRCULAR PLAN.

TO make the working drawing of this Arch more easily understood, let us draw the plain plan, elevation and section. Draw the elevation, **FIG. 2,** to the required size, then take **X A** for the radius, and draw the plan **FIG. 1,** to the required size; now draw a section through **O X, FIG. 2;** make **A B** to the required batter, and **A 1** the required width, as shown at **A 1** in plan.

To make the working drawing and moulds, see page 19.

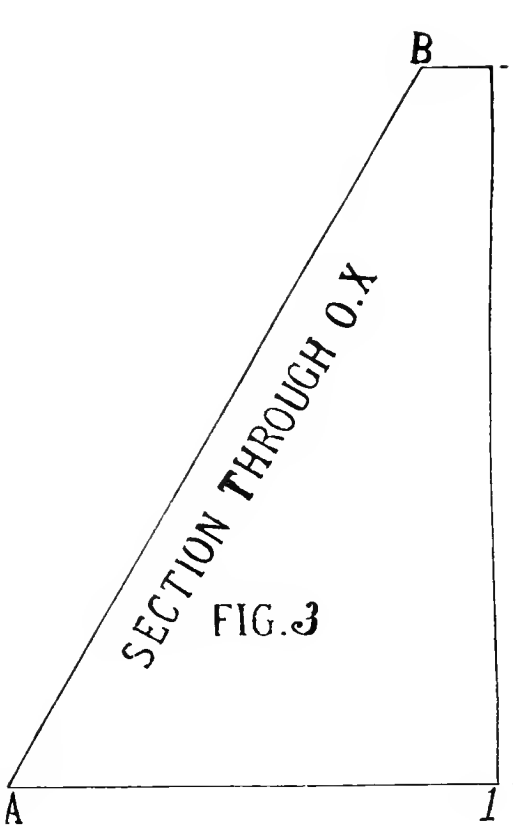


FIG. 3

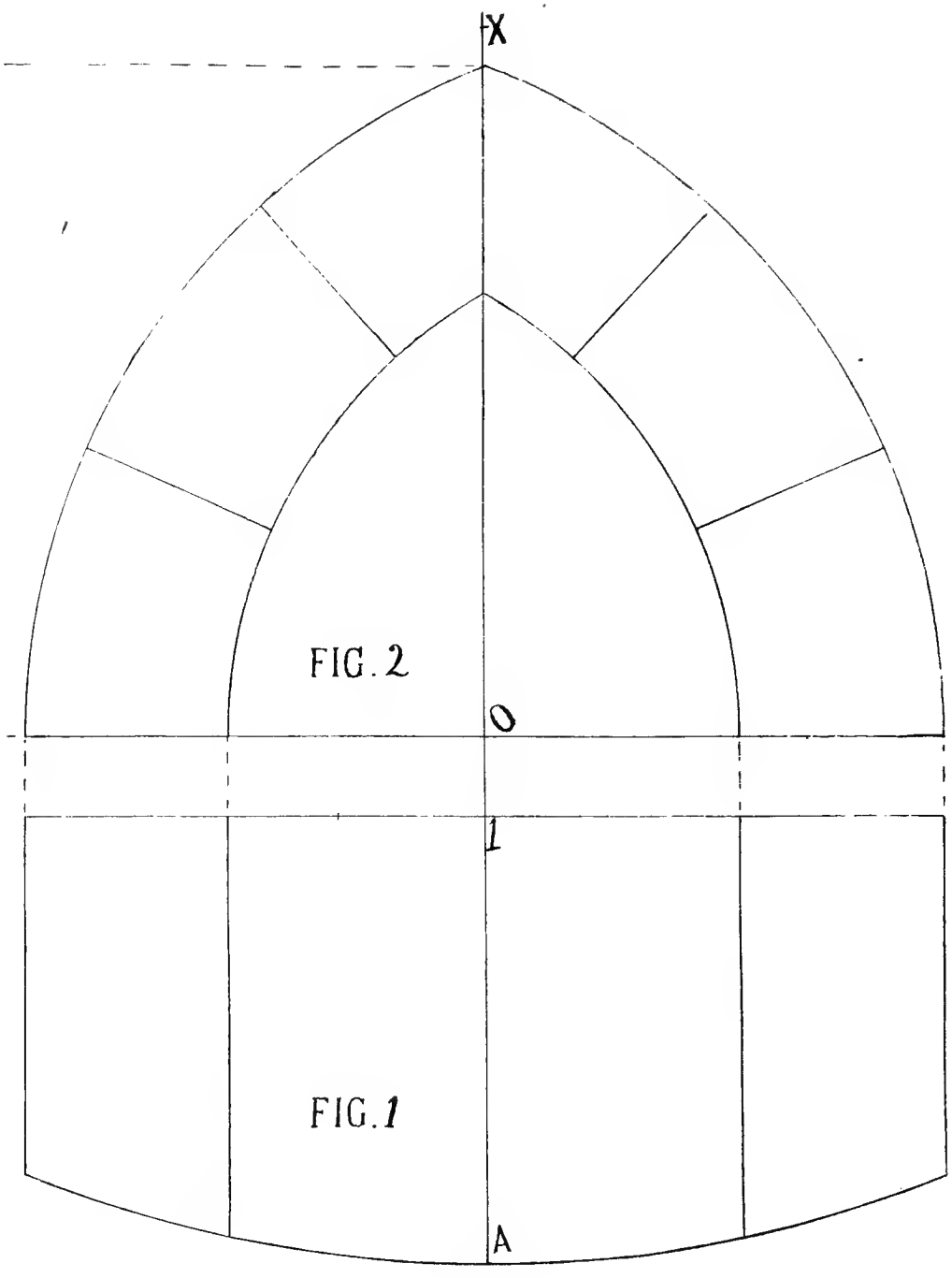
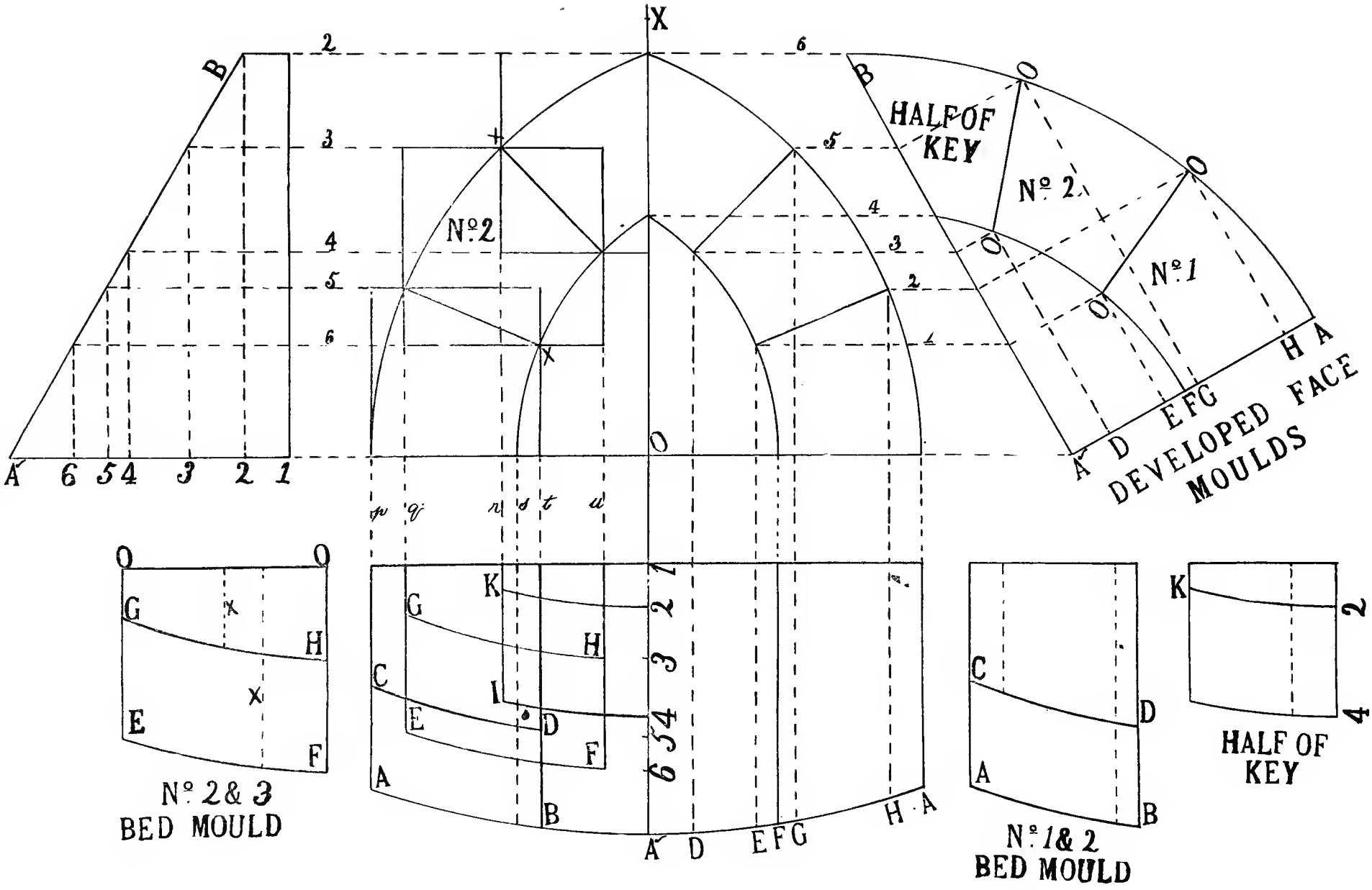


FIG. 2

FIG. 1

BATTERING ARCH, ON A CIRCULAR PLAN.

TO make the Moulds for this Arch, draw a plan, elevation and section, to the required size, as explained on page 18. Now draw the size of the block required for each stone, as shown on elevation, then from the joints and top and bottom of each block, draw the dotted horizontal lines **2 3 4 5 6** to the line **A B;** then from the different points at **A B** draw the perpendicular dotted lines **2 3 4 5 6;** now we have the different points required from which to make the bed moulds. Let us make them.—First carry the different points, as **A 6 5 4 3 2 1** from section, and mark them on the center line through plan; then from the sides of each block, draw the perpendicular lines **p q r s t u.** Now take **X 5** for the radius, and draw the line **C D,** then take **X 6** for the radius, and draw the line **E F;** then take **X 3** and draw **G H,** then take **X 4** and draw **1 4,** then **X 2** and draw **K 2.** Now we have the required bed moulds, as shown by **Nos. 1** and **2, 2** and **3** and **HALF OF KEY,** all taken from the plan. Now let us develop the face, so as to have a face mould that will apply to a battered circular face.—To do this we will work from the other half of the plan and elevation, so as to have the lines clear of those we have already obtained. Draw the line **A B** to the same angle as the section, then draw the horizontal lines **1 2 3 4 5 6** to the line **A B;** now draw perpendicular lines from the different points of **1 2 3 4 5** at elevation, to **D E F G H** at plan; then draw the line **A A** (at developed face) square to **A B,** and carry the points **A D E F G H A** from around plan, and mark them on the line **A A,** and from these points erect perpendicular lines; then from the different points of **1 2 3 4 5** and the line **A B,** draw lines to intersect the perpendicular lines **D E F G H.** Now draw the joint lines from the points **O O O O,** and find the radius for the soffit and top lines in the same way as explained for **FIG. 1,** page 2. In this case we must find two centers—one for the soffit line and another for the top—because the top is not parallel to the soffit. Now we have the required moulds. Let us cut one of the stones—say **No. 2.**—First cut the top and bottom bed to the required height, as taken from elevation, then cut a square draught through the right-hand corner, so that a line can be drawn to set the bed mould to. Now apply **Nos. 2** and **3** bed mould; mark the lines **O E O F** on the bottom bed and **O G O H** on the top bed; now cut the face to these lines and you have a battered circular face. Now take **No. 2** developed face mould, and set it to the four points of the face (as shown at **No. 2** in elevation) and mark it on; then take **No. 2** face mould from the elevation and mark it on the back of the stone; now cut the joints, soffit and top. The lines **x x** on the bed mould are the lines through **x x** as shown on elevation.


X
B
2
3
4
5
6
A 6 5 4 3 2 1
N°2
HALF OF KEY
N° 2.
N° 1.
O
H A
A D E F G
DEVELOPED FACE MOULDS
p q n s t u
K
G
H
C
I
E
D
F
A
B
6 5 4 3 2 1
A D E F G H A
N° 2 & 3 BED MOULD
N° 1 & 2 BED MOULD
HALF OF KEY

RAMP AND TWIST.

TO set out this problem it is necessary to find the radius of the plan and the pitch of a portion of the elevation, which are both obtained from the plan and elevation of this kind of work. In this case FIG. 1 is the plan of a quarter cylinder; the line A B is the pitch. FIG. 2 is the plan developed, showing the mould to be applied to the top and bottom bed of the stone. FIGS. 3 and 4 are the falling moulds, to be applied to the edges of the stone. FIG. 5 shows the edge of the stone, with the top and bottom bed mould turned up. FIG. 6 shows the edge and bed of the stone with the top and bottom bed mould in the position they would be in when drawn on the top and bottom beds of the stone.

Now draw the plan, FIG. 1, and mark off the length of the stone required—in this case we have divided the quarter cylinder into halves. Now divide the stone required into any convenient number of parts, and from the center E draw the radiating lines X I X I X I X I; then draw perpendicular lines from the inside and outside points of X I X I X I X I to the raking line A B, then draw them again perpendicular to A B; now carry E F and E G from FIG. 1, and mark them at FIG. 2. Use the string method for drawing the elliptic arch, and draw the inside and outside curves of FIG. 2, and from the points where the perpendicular lines touch the inside and outside curved lines draw the radiating lines 1 2 3 4; that finishes the top and bottom mould. To make the falling moulds, draw a line, as H 1, and carry the points F X X X X and G I I I I from inside and outside lines of plan, and mark them on the line H 1, and from each of these points erect perpendicular lines. Now draw a line, as J K, to the required height as shown from C to D, and from the points where the line J K touches the perpendicular lines G and F draw the lines O X and O I. Now make O O equal to the height of the joint mould, and draw lines parallel to O X and O I; that finishes the falling moulds. Now draw FIG. 7.—Make its height equal to the height of the joint mould, then draw a line, as V V, across the point and parallel to the line A B, and U V will be the thickness of the stone required. It will be necessary to draw FIG. 6 to find the full size of the stone required. First draw the top and bottom mould a b c d, setting its points to a line, as X X, then draw another line parallel to X X and to the required thickness, as taken from FIG. 7. Now draw the lines c k and d i to the bevel, as taken from the pitch line A B and shown by the bevel, FIG. 8; then from the points k i mark M N, as shown by dotted lines. Now mark the top and bottom mould again, setting its points to the points M N, and X X X X with the thickness X g will be the size of the stone required. To cut this stone, work the top and bottom beds X X X X to the required thickness, X g, as shown at FIG. 6; mark the mould on the top bed, as No. 1 at FIG. 5 would be if it was laid down. Now square a draught through the inside edge of the stone, taking care to keep the square in the direction of the lines X X 1 2; then use the bevel, FIG. 8, and draw the line 1 2 through the draught. Now take 2 0 out of twist with 1 0, then mark the mould on the bottom bed, as No. 2 would be if it was turned under. Now cut the joints and inside and outside edges, then mark the lines off the bed mould on to the edges of the stone and apply the inside and outside falling moulds; the lines on the falling moulds will fit those on the edges of the stone and will be plumb when the stone is in its right position. Now mark the joint mould on, and cut the top and bottom, taking care to apply the straight edge in the direction of the lines on the bed mould. It will be seen that one end of the bed mould is larger than the other. If we look at X U above FIG. 7, we will see there is that much twist on this stone, and when that is cut off it leaves both ends of the stone the same size.

It will be seen by this problem that it is only necessary to make moulds for one stone. In this case we have divided the quarter cylinder into halves, and made moulds for one of these halves, therefore it would take two stones to cover the quarter, or eight stones to cover the whole cylinder. If the reader will study this problem, he will see that cheak blocks, or in fact anything in connection with this problem, can be set out in the same way as we have set this out. Always work from the plan, FIG. 1, the base line E H and the pitch line A B.

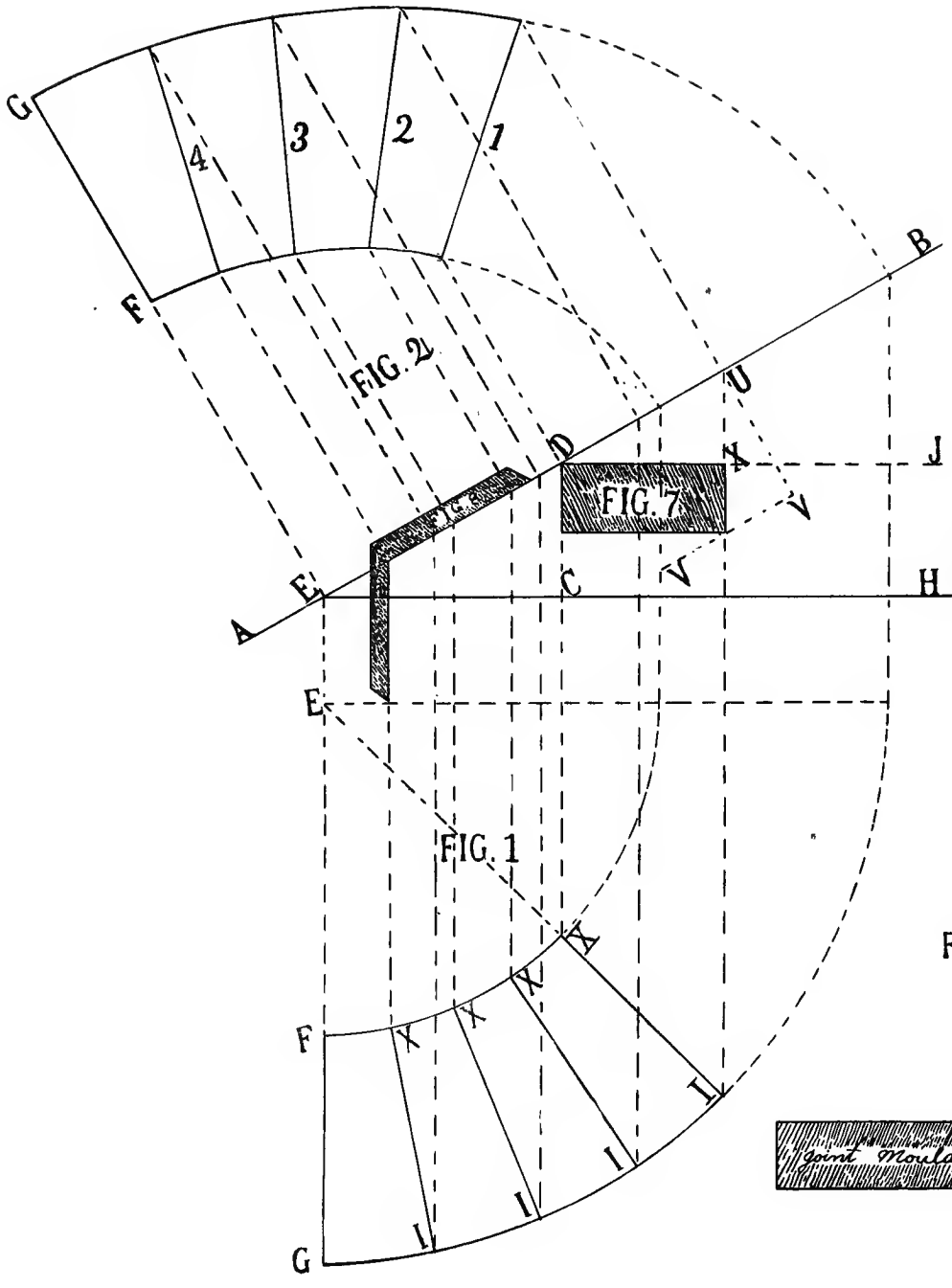


FIG. 2

FIG. 7

FIG. 1

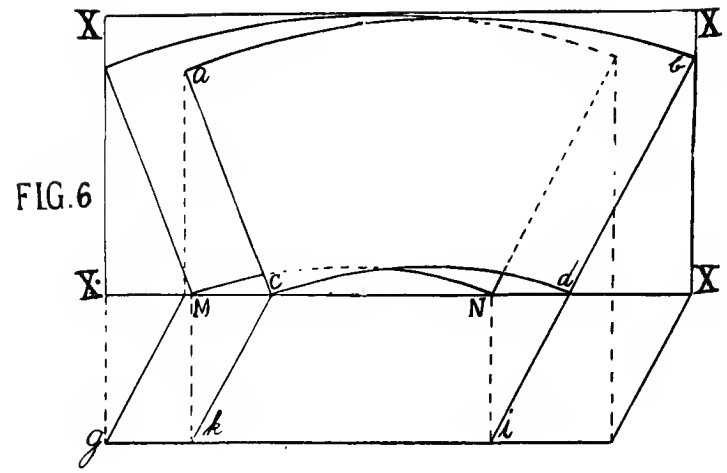


FIG. 6

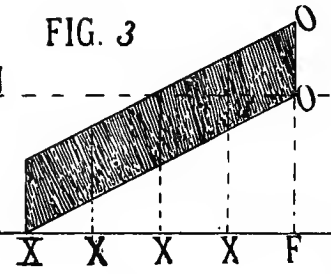


FIG. 3

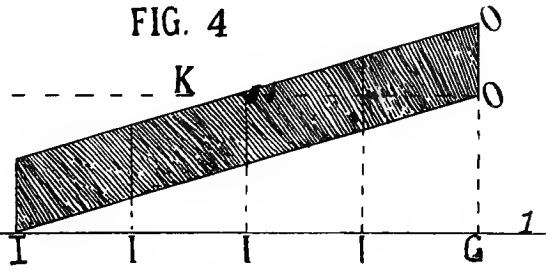


FIG. 4

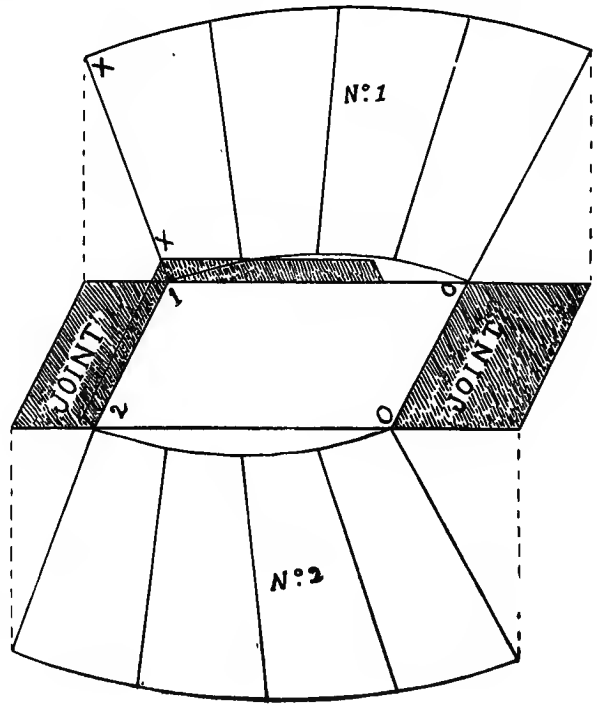


FIG. 5

Joint Mould N°1

PRESS OF
MILLER BROTHERS,
ALLEGHENY, PA.